APRIL 1927—THIRTY-THIRD YEAR

MACHINERY

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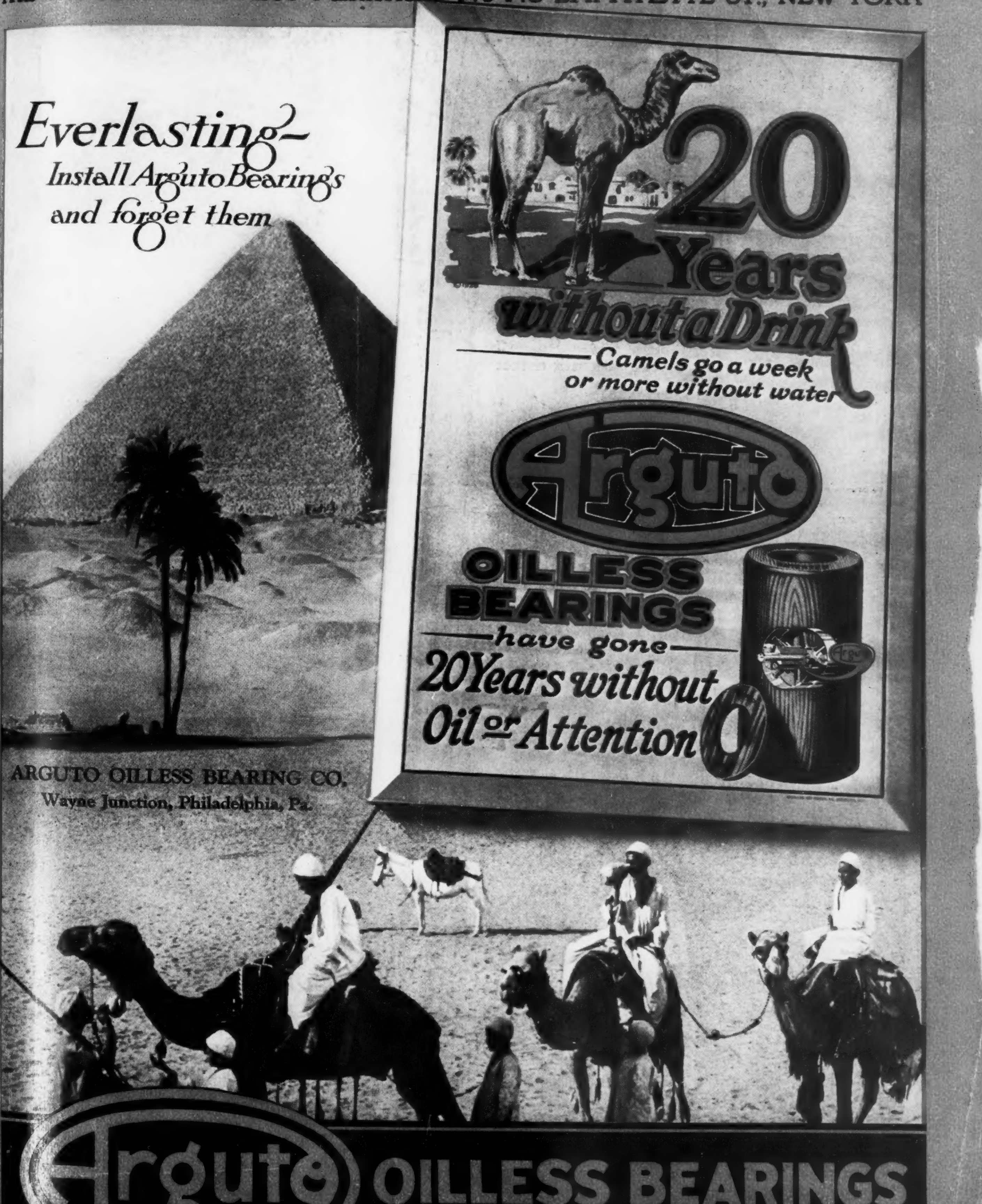

MACHINERY

DESIGN — CONSTRUCTION — OPERATION

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A Mechanical Achievement

The most important standardization work ever undertaken in the machine tool industry has just been completed by the milling machine manufacturers of the National Machine Tool Builders' Association. Nine makers of milling machines from 2 to 25 horsepower capacity have adopted a uniform spindle end for every size and type of machine made by them within the capacities specified, ensuring complete interchangeability of arbors and face milling cutters for any size and make of milling machine in this capacity range. Future buyers of milling machines therefore will not need a separate set of arbors and cutters for each type and make of machine in their shops. Fifteen standard arbors, which will fit any machine of the nine makers, take the place of 250 different arbors made by the same manufacturers in the past.

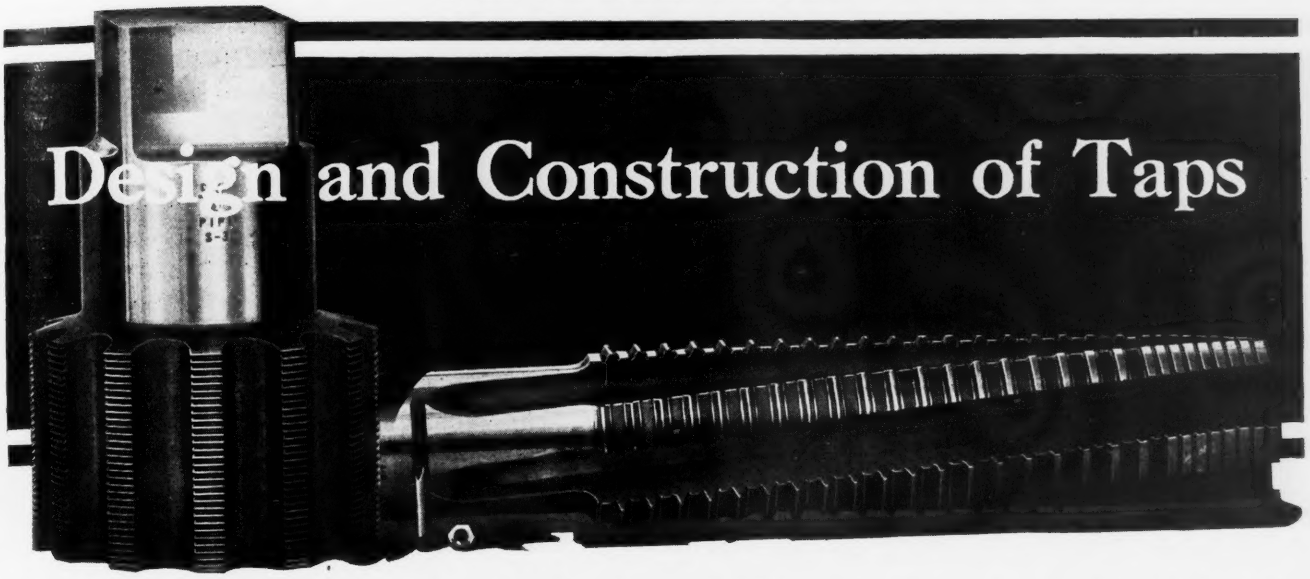
All the nine milling machine manufacturers have scrapped their former spindle designs, embodying patented features and competitive advantages, and beginning with this month the new spindle is used by all of them.

Real courage was required to reach this decision, and it was adopted without any effort to save certain features of existing designs by compromises. The engineers of the different companies collaborated in producing what, in their opinion, is the best possible design for the spindle end of milling machines, and once the best was decided upon, it was adopted without compromise or change, in the interest of the machinery industry as a whole.

The saving to machine tool users will run into large figures, for the reduction in the cost of milling machine equipment by the elimination of several hundred sizes and varieties of arbors and cutters will mean greater production at less cost in every machine shop.

Competitors who have the courage and vision to initiate an improvement of this character for the benefit of the machinery industries, set an example that would produce far-reaching results if followed generally.

They are truly master builders of master tools.



Design and Construction of Taps

With Special Reference to Taps having Ground Threads—First of a Series of Articles

By A. L. VALENTINE, Manager, Tap and Gage Division, S K F Industries, Gothenburg, Sweden

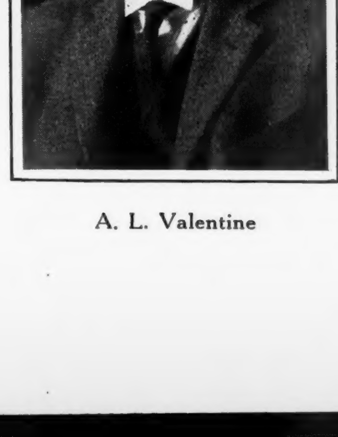
UNTIL a few years ago, the only taps available for threading small holes were those on which the threaded part was finished before hardening. It is well known that the hardening process introduces many errors in the tap thread and, hence, if the thread cannot be finished after hardening, the cutting qualities, durability, and accuracy are impaired. Readers of MACHINERY interested in this treatise know that until the development of a tap ground in the thread after hardening, it was impossible to eliminate the inaccuracies inherent in the tap finished before hardening. To fully appreciate what these inaccuracies are and how they are avoided by the use of taps ground in the thread, it is necessary to understand what difficulties are most frequently encountered due to taps not being ground in the thread after hardening.

Errors in Unground Thread Taps that are Caused by the Methods of Manufacture

When, as is usually the case, the fluting of a tap is done after the threading operation, heavy burrs are generally found between the threads. It is impossible, even with the most careful fluting and flute grinding operations, to wholly remove these burrs. Hence, when tapping a hole, these burrs break off and stick to the material in the nut; and because of their hardness, they spoil the sharp cutting edges of the tap. Furthermore, until the burrs have been entirely worn away, the threaded surfaces in the nut are scored and full of ridges.

To avoid burrs to the greatest possible extent, the steel from which the tap is made should have a certain degree of hardness, which, however, must not be too great, because it must be possible to perform the threading operation with ease, so that the thread cutting tools do not have to be ground too often. To avoid burrs is of advantage in the manufacture of ground thread taps also, because the burrs have to be ground away when grinding the thread, and this not only takes time, but also spoils the shape of the grinding wheel, and hence, increases the cost of the operation.

Another fault due to the mechanical operations of producing the tap is the so-called "drunken" thread. This difficulty is principally due to uneven backlash or play between the lead-screw of the thread cutting machine and its side bearings in the lead nut. As shown in Fig. 1, in which both a tapered and a straight tap with such threads are shown, the threaded hole in the nut tapped with such a tap is incorrect. The thread form varies from point to point, and the thread spaces are too wide, so that the fit between the nut and the screw will be unsatisfactory. In Figs. 2 to 7, inclusive, are shown other faults in the fits of threads due to incorrect threads in the taps. The captions for the illustrations make clear the causes of the errors in the different examples.



A. L. Valentine

A. L. VALENTINE was born and educated in Sweden. In 1892 he came to the United States and became an apprentice with the Pratt & Whitney Co., Hartford, Conn., remaining in this company's employ for twenty-seven years, the last eighteen as superintendent of the Small Tool Division. In 1919 he left the Pratt & Whitney Co. and was engaged by a company in France to build and equip a factory in that country for the manufacture of all kinds of small tools. After the completion of this work in 1922, he became connected with the S K F Ball Bearing Co. of Gothenburg, Sweden, the parent company of the S K F Industries, Inc., of New York, as manager of this company's department for the manufacture of "finished-after-hardening" taps, gages, and other tools, which position he still holds. The manufacture of small tools has been his life work, and he is unusually well trained and equipped for the preparation of the series of articles to be presented in MACHINERY. Mr. Valentine is a member of several engineering societies in this country and Europe, among others the American Society of Mechanical Engineers and Societe des Ingenieurs Civils de France. He is also vice-chairman of the committee on thread cutting tools of the Swedish Standards Commission.

During the hardening operation, errors are often made which reduce the usefulness and durability of a tap. Some of these errors affect both ground and unground taps, but others can be eliminated by grinding, and these are the ones with which we are concerned.

The most important faults of this kind are distortion, expansion or contraction, and softness of the outer thread surface. This last mentioned difficulty may be due either to decarburization of the steel or to unsuitable quenching baths. If the soft surface does not extend too deeply, the grinding of the threads after the hardening operation will eliminate this fault.

The series of articles on the design, construction, and use of taps beginning in this number of MACHINERY, which is written by a man who has been engaged for more than thirty years in this line of manufacture, is a most comprehensive treatise on the subject. The present article—the first in a series of eight—deals with some of the preliminary considerations in the production of accurate threads. Later articles will consider the actual construction of taps, straight and spiral flutes, form of flutes, chip room, different forms of cutting edges, relief, and chamfer. Different types of taps will be discussed, methods of accurate thread measurements will be dealt with, experiments with lubricants used in tapping, and the results obtained, will be referred to, and directions will be given for obtaining the best results in the use of taps, including instructions for sharpening, the use of suitable tapping speeds, and correct methods of holding taps and nuts.

The steel used causes many faults in taps, because they cannot maintain the shape and dimensions that they had before hardening, after this process has been performed—even though the hardening process is correctly performed.

Distortion in Taps After Hardening

Figs. 8, 9, and 10 show bent taps and holes threaded with them. Crooked taps are more often caused by faulty steel than by wrong heat-treatment. The holes tapped with such taps become larger than the taps themselves, and the thread profile is inaccurate, because the tap has a longer lead on the convex side than on the concave. If the hole threaded with such a tap is "bottoming," it will also be tapered.

The tap shown in Fig. 11 is oval. The work, when threading a hole with such a tap, is done principally by the two high cutting edges or lands opposite each other. The tap will jump, vibrate, and lead badly in the hole while tapping; the tapped hole will be out of round, and will have irregular threads, and the tap will wear out quickly.

In Fig. 12 is shown a tap in which the lands have bent forward during the hardening operation. This tap has lost all its cutting qualities, especially if the threads have not been provided with relief before hardening. Such a tap has now a "negative relief," and instead of cutting during the threading operation, it will become wedged in the nut and will probably break soon after being started.

In Fig. 13 is shown a tap in which the lands have been bent backward. This tap, even though it has not been provided with relief in the threading operation, obtains relief through the hardening process. Should it, however, have been relieved before the hardening operation, the additional bending of the lands backward makes this relief excessive, and the tap will vibrate while tapping, the threaded hole will not be round, and the threaded surfaces will be covered with vibration marks.

The bending of the lands in either direction can be prevented, or at least reduced, by a proper form of flute in the taps. The bending of the lands occurs most frequently in taps fluted with a convex cutter, such as was used for the taps shown in Figs. 11, 12, and 13. The form of flute is a particularly important feature in the construction of taps, whether ground or unground, and this subject will be more fully treated in a later article in this series.

Fig. 14 shows a threaded hole tapped with a tap having a wrong lead. It is impossible, even with the most careful control of the composition and physical properties of the steel and of its heat-treatment, to entirely prevent elongation or contraction during the hardening process or to insure the uniformity of such elongation or contraction. Even in a quantity of taps hardened at the same time, under the same conditions, and with the same treatment, the change in lead will be different in different taps, although they are all made from bars of steel from the same heat. It is, therefore, impossible to compensate with any degree of accuracy for these lead errors in the thread, by threading taps before hardening with

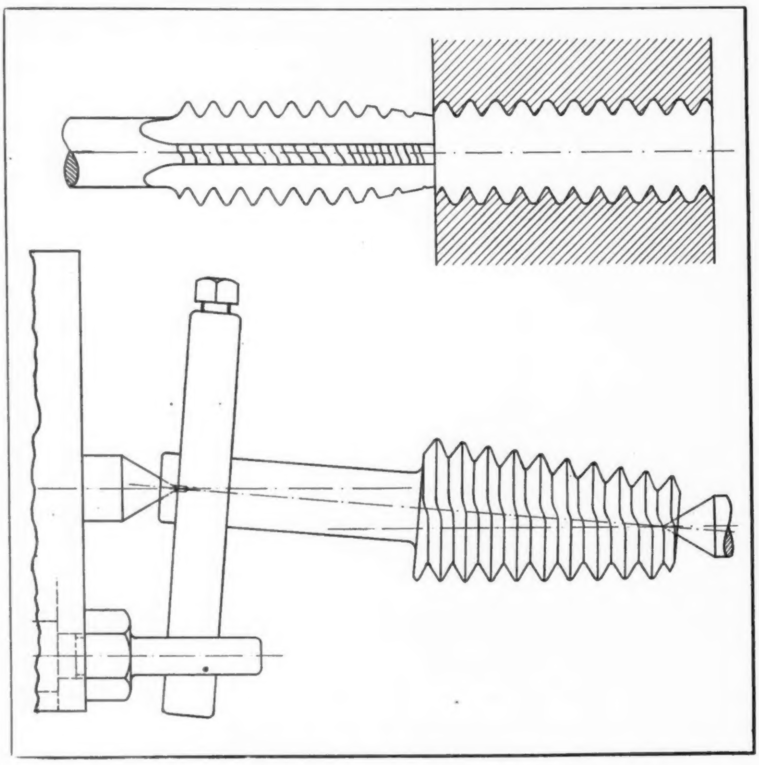


Fig. 1. Straight and Conical Taps with Drunken Threads, Together with Hole Tapped with a Straight Tap

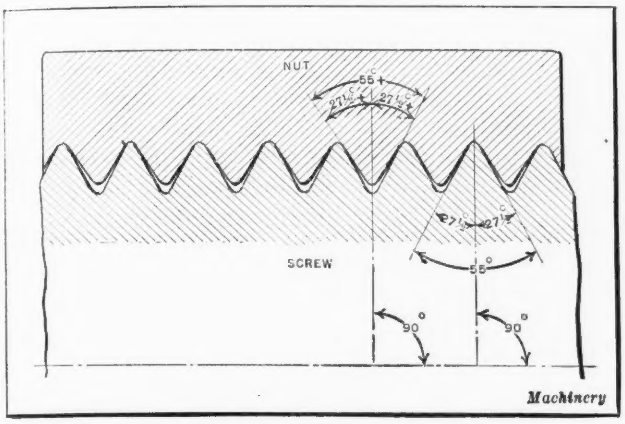


Fig. 2. Example Showing Correct Lead, but Incorrect Pitch Diameter and too Large Thread Angle in the Nut; Correct Lead, Pitch Diameter, and Thread Angle in the Screw

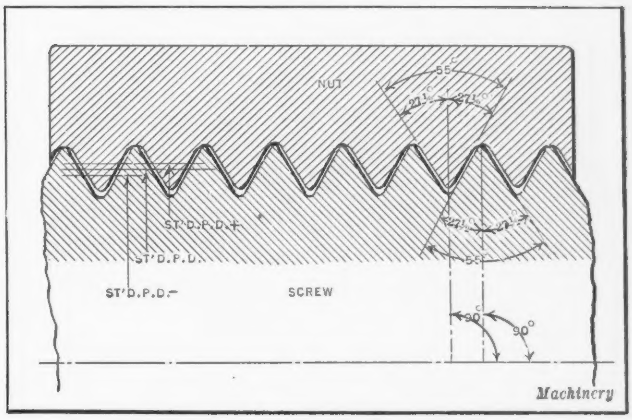


Fig. 3. Correct Lead and Thread Angle in Both Nut and Screw; Same Outside Diameter in Nut and Screw, but too Great Pitch Diameter in Nut or too Small Pitch Diameter in Screw

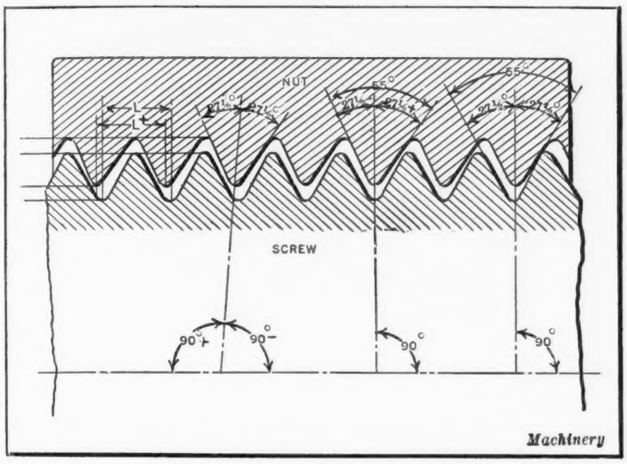


Fig. 4. Incorrect Lead in Nut; Thread Angle of Correct Measure, but not Symmetrically Located Relative to Center Line of Nut; Correct Lead and Thread Angle in Screw

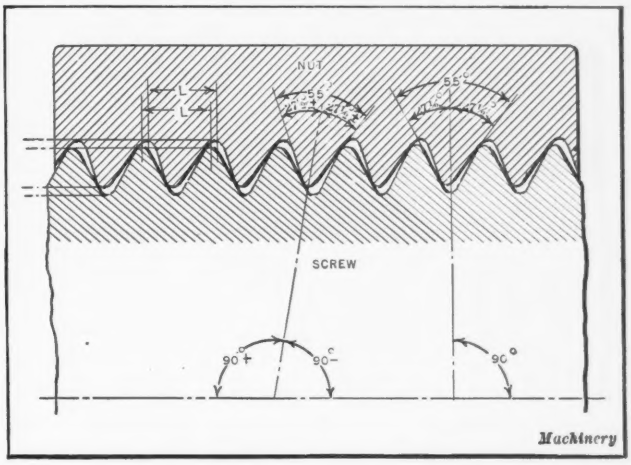


Fig. 5. Correct Lead but Incorrect Thread Angle, not Symmetrically Arranged with Reference to Center Line in Nut; Correct Lead and Thread Angle in Screw

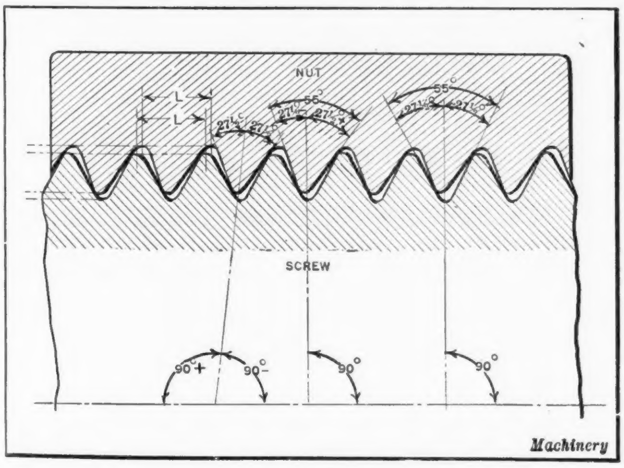


Fig. 6. Correct Lead in Nut; Thread Angle, while of Correct Measure, not Symmetrically Located with Reference to Center Line of Nut; Correct Lead and Thread Angle in Screw

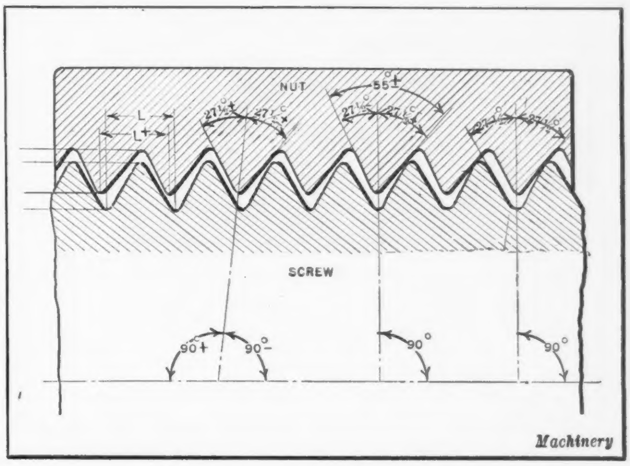


Fig. 7. Incorrect Lead and Incorrect Thread Angle, not Located Symmetrically with Reference to Center Line of Nut; Correct Lead and Thread Angle in Screw

long or short lead. Complete interchangeability with accurate fits in threaded holes tapped with unground taps is, therefore, not to be expected. Under these conditions, to obtain a good fit between screws and nuts (which fit, however, is only apparently good) it is necessary to make the screws of different diameters from the tap, the extent of the difference depending principally upon the different amounts of lead error existing in the tapped holes.

Screw and Nut with Different Leads

If an actual section is taken through the nut and screw referred to in the preceding paragraph as having an apparently good fit, it will be seen, as shown in Fig. 14, that only one side of a thread in the screw bears at one end of the nut, and that the opposite side of the thread in the screw bears at the other end of the nut. The size or length of the contact surface between the two threads in contact depends on the amount of the lead error. The

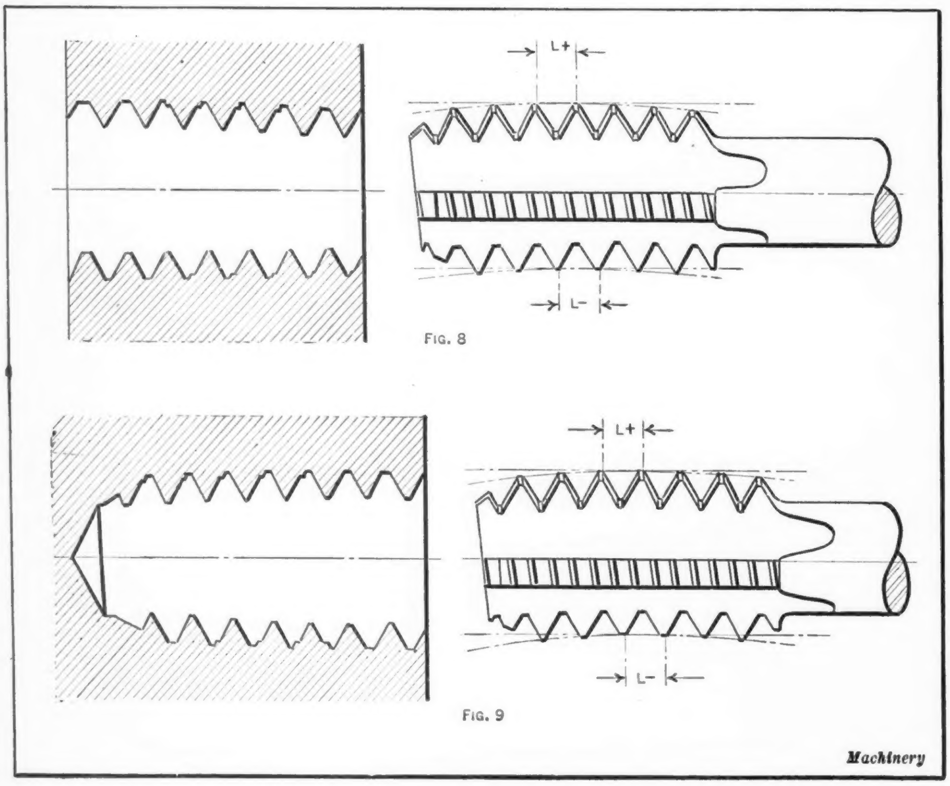


Fig. 8. Tap with Threaded Part Bent, but Shank Straight, Tapping a "Through" Hole
Fig. 9. Tap with Threaded Part Bent, but Shank Straight, Tapping a "Bottoming" Hole

greater the error, the smaller are the surfaces in contact.

When a screw of correct lead is forced into a threaded hole of incorrect lead, the load is first taken by one thread which is then forced out of position until the next thread comes in contact and assumes part of the load; these two threads are then deformed until the third thread assumes part of the load, and so on. Should the lead error be so great, however, that when, for example, the fourth thread comes in contact and assumes part of the load, the first thread is stressed beyond its elastic limit, then there will be only three threads that will do any work, and an increased length of nut will be of no value and will not add to the strength of the bolt and nut.

The only way to maintain the accuracy of a screw and nut for a maximum length of time is to have every thread in the screw in contact with every thread of the whole length of the nut. This can only be accomplished when the lead is correct or when both screw and nut have the same error in the same direction; or when the lead in both is so nearly alike that when the screw has been forced through the whole length of the nut, no threads in either member have been distorted sufficiently to lose their strength or holding power.

In modern machine tools, it is common practice to make the length of the nuts for lead-screws and feed-screws from one and one-half to two times the diameter of the screw. If the lead is correct in both, or if the lead error is the same and in the same direction in both, there is no reason why the nut should not be made still longer, thereby increasing its strength, wearing qualities, and length of life.

Diagrams may be constructed, and some of these have been published in MACHINERY in the past, showing the relation between the lead and the pitch diameter. From such diagrams it may be determined, for example, that in order that a screw with correct diameter and lead may pass through a nut having incorrect lead, without binding, the pitch diameter of the threaded hole (or of the tap) must be a given amount over-size, according to the error in the lead.

For example, if a 60-degree thread has an error in lead in one inch length of the tap of 0.003 inch, then the pitch diameter of the tap should be approximately 0.005 inch above the nominal diameter, in order that a screw of accurate diameter and lead may screw into a nut one inch long. In a Whitworth thread with 55-degree thread angle, the same lead error would require a somewhat greater allowance on the pitch diameter—almost 0.006 inch. From such a diagram, tables may be constructed that will give directly the amount of increase in pitch diameter necessary for given lead errors per inch, for any given diameter of tap with any number of threads, standard or special.

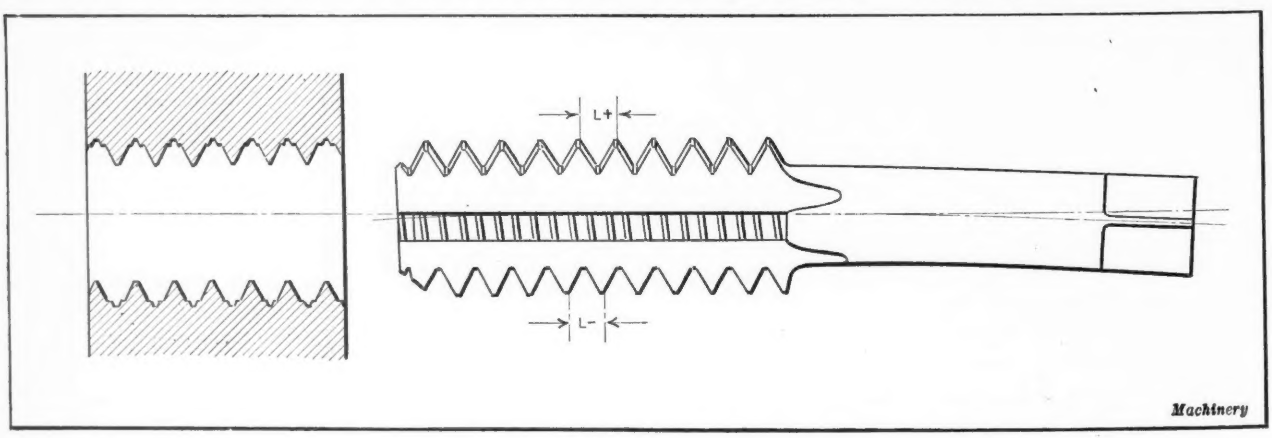


Fig. 10. Tap Bent Throughout its Entire Length

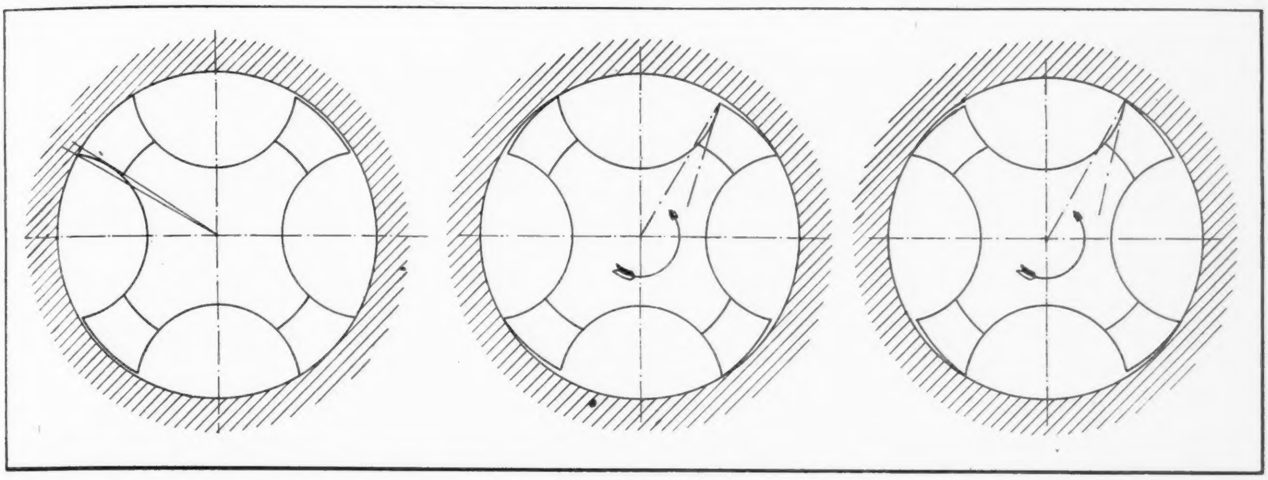


Fig. 11. Tap that has been Sprung to an Oval Shape in Hardening

Fig. 12. Lands of Tap Bent Forward in Hardening; Tap not Relieved before Threading

Fig. 13. Lands Bent Backward in Hardening; Tap not Relieved before Hardening

The following formulas give the relationship between the lead error in one inch length of thread and the over-size dimension of the pitch diameter:

Lead error in 1 inch = over-size dimension required on pitch diameter × tangent of 1/2 thread angle; or

Over-size required on pitch diameter = lead error in 1 inch × cotangent of 1/2 thread angle.

Should the screw also have a lead error as great as that in the tap, but in the opposite direction, which is not uncommon, then the tap would have to be over-size twice the amount indicated by the formula above.

During the hardening operation, the lead often varies in different parts of the same tap, probably because the extreme threaded end of the tap is subjected to more abrupt and sudden cooling than other parts of the tap. In that case, the thread spaces in the tapped hole will become too wide, and if the hole is "bottoming," both diameter and lead will vary at different points.

The diameter and thread form of a tap also change during the hardening operation to the same extent as the lead, and not even with the most careful control of the steel and its hardening and tempering treatment, has it been found possible to compensate with any degree of accuracy for these changes due to the heat-treatment operations.

In Fig. 15 is shown a perfect fit between a screw and nut when both pitch diameter and lead fully agree. The accuracy, holding capacity, driving power, and length of life of threaded parts with such fits need no comment. The confidence with which a machine or device equipped with such threaded parts can be put on the market is apparent.

Influence of the Chamfer on Taps

As the chamfer of a tap that is not ground in the thread is often ground after hardening, and as the tap is at that time more or less crooked (in spite of all efforts that have been made to straighten it after hardening), the chamfer will be uneven and of different length on the different lands of the tap. As a result, some of the lands will not do their share of the work in tapping, while others will be overloaded and wear faster. It must be borne in mind that the chamfered part of the tap is the part that does the cutting and is, therefore, of the utmost importance as far as the cutting qualities of a tap are concerned. Hence, the effects of incorrect chamfer are serious, and improperly chamfered taps wear quickly and break easily. If the chamfering is done before hardening, concentric with the threads, the results will still be unsatisfactory, because the tap bends more or less during the hardening operation and can never be entirely straightened. The best results can be obtained only by grinding both the thread and the chamfer after hardening.

In the following articles, the author will discuss additional difficulties in obtaining accuracy in taps, and the need for ground thread taps.

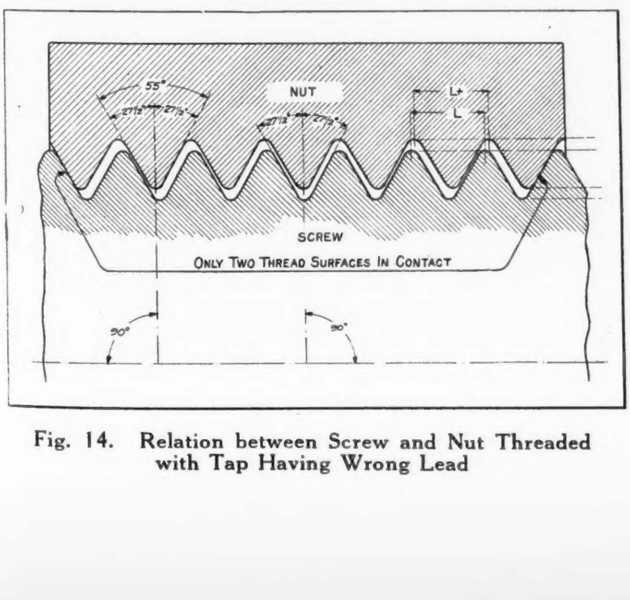


Fig. 14. Relation between Screw and Nut Threaded with Tap Having Wrong Lead

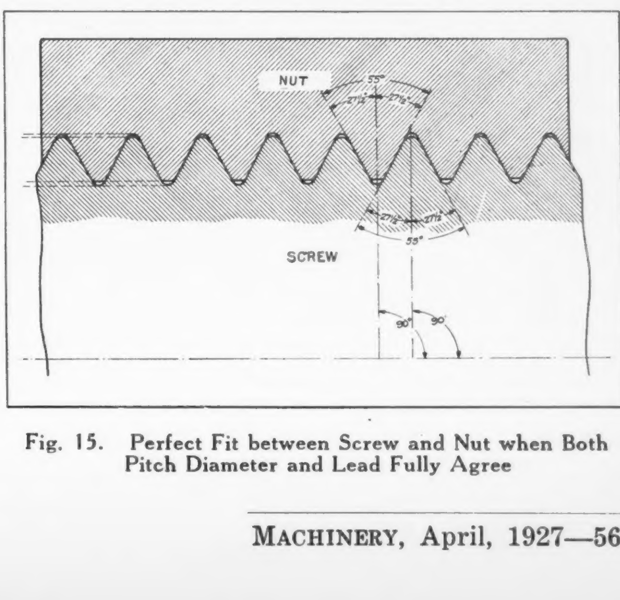


Fig. 15. Perfect Fit between Screw and Nut when Both Pitch Diameter and Lead Fully Agree

What MACHINERY'S Readers Think

Contributions of General Interest are Solicited and Paid for

WHY DO WE STICK TO THE T-SQUARE AND TRIANGLE?

Every now and then we read of a kink for making a T-square more efficient or a triangle do more work. In the final analysis, these kinks and improvements seem like adding ball bearings to the wheels of an ox-cart or devising an attachment for a candle snuffer.

It is remarkable that in hundreds and probably thousands of plants where it would be considered a disgrace to use a lathe that is not equipped with all the latest attachments, and where it would be considered ridiculous if every desk in the office were not provided with a telephone, the drafting-room is still equipped with drawing-boards that rest on horses and T-squares that rest on top of the board. When one compares the first cost of a drafting machine with the cost of operating a T-square and triangle, it is a wonder that all T-squares and triangles were not discarded years ago.

A girl who writes a few words on a card or fills in dates on time cards is supplied with a solid oak desk, a good typewriter, and a nice restful swivel chair, and why not? The same girl would not do nearly so much work if she were supplied with a quill instead of a typewriter and made to sit on a high stool. The engineering staff of the same concerns, however, is still propped up on high stools, and worst of all, made to manipulate the old inefficient T-square. Let's scrap all out-of-date equipment, whether it is in the shop, office, or drafting-room, and replace it by new, modern, and money-saving tools. EDWARD HELLER

* * *

QUESTIONS FOR FOREMEN

The machine shop foreman who is ambitious to increase the efficiency of his department would do well to consider the following questions:

Do I look upon my department as a unit and give orders without taking the temperament of the individual worker into consideration? Do I give too many orders? How many times do I issue an order that only irritates the worker and makes him feel resentful toward me? How many orders do I issue personally that might better be transmitted by some subordinate? Is it possible that I could secure better results by giving fewer but more carefully considered orders?

Whenever a new employe is taken on, do I see that he is made fully acquainted with all the men in the department so that he feels at home? If I see to it that he is made to feel at ease, will he not be less likely to leave his job before he has had time to become acquainted with the other men and his work? Would it not pay to welcome the newcomer cordially and make him feel that he is considered a worthy addition to the department?

Do I always investigate thoroughly the reason why an employe leaves? Do I keep an old employe with a new man long enough to give the newcomer confidence to carry on his work alone? How much poor work results from leaving a new man to himself too soon?

Do I treat all employes impartially so that no one can justly find fault? When a man does not do the work expected of him, is it because of inexperience, dislike for the work, or lack of interest or enthusiasm? Would it benefit the department, and the plant as a whole, to transfer men to different work when conditions are favorable to such changes? How many men do I now have who are not doing the kind of work for which they are best adapted? How many men are dissatisfied with their work and to what extent is quality and quantity of output suffering simply because of misplacement? When a man tells me he is going to leave, do I try to make him change his mind by finding him other work in the department more to his liking and better adapted to his abilities?

How many men are there in my department who might be able to improve themselves and their work and increase the output by reading and studying technical magazines? Would it not pay me to check certain articles and items and bring these to the attention of the men, particularly the young and inexperienced employes? Would not a better get-together spirit be obtained by holding meetings periodically for the purpose of discussing various articles and topics found in technical publications? In this way could I not obtain a better idea of the ambitions, knowledge, opinions, and abilities of the different employes and thus be able to improve the management of my department?

Do I encourage suggestions from each worker? Do I ever say "If you can think of a better way to do that let me know and we'll try it out?" Do I show my appreciation when an employe offers a worthwhile and useful idea? Is my department being held back by the lack of up-to-date machinery and methods? Do I spend enough time seeking for possible improvements? Is there enough system and cooperation with other departments? The foregoing questions are but a few of many worth considering, some of which may point the way toward worthwhile improvements.

FRANK V. FAULHABER

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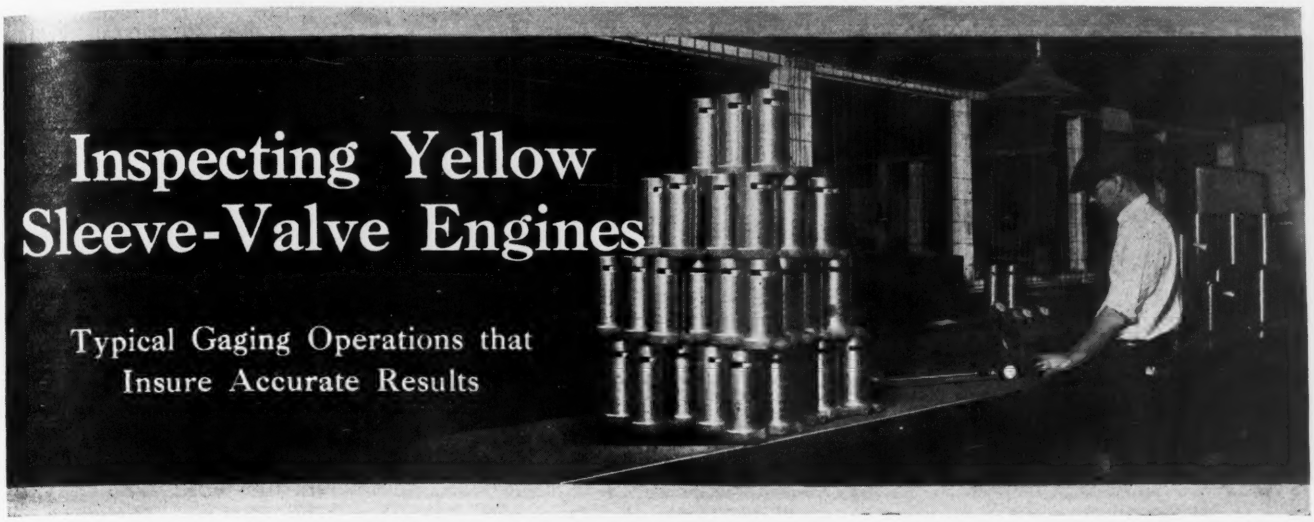
SURFACE GRINDING IN AUTOMOTIVE SHOPS

An article on surface grinding developments in automotive plants, to be published in May MACHINERY, will prove of great interest to everyone engaged in quality and quantity production. Grinding has been adopted for many operations in every metal manufacturing field, and the automotive industry, particularly, has applied it for a variety of operations formerly done in other ways.



Inspecting Yellow Sleeve-Valve Engines

Typical Gaging Operations that Insure Accurate Results

By CHARLES O. HERB

PARTS assembled into the Knight sleeve-valve engines built by the Yellow Sleeve-Valve Engine Co., Inc., East Moline, Ill., are subjected to rigid inspection during the process of manufacture and after they are completed. Important castings are also carefully examined when they are received from the foundry to make certain that sufficient stock exists on the various surfaces to permit machining the castings to the specified dimensions. A few of the most interesting inspections performed in this plant will be described in the following.

Checking Valve Sleeves

Limits of plus or minus 0.00025 inch are specified on both the inside and outside diameters of the valve sleeves, and these sleeves are permitted to taper only an amount within the diameter tolerances. The maximum out-of-round tolerance at the upper end of a sleeve is 0.004 inch, and at the lower end, 0.002 inch. To the left of the inspector in the heading illustration, there may be seen the three-point dial indicator employed for checking the bore of sleeves. The inspector is shown engaged in checking the outside diameter at various points. Close-up views of two inspection fixtures of the type that the man is using appear in Fig. 1.

When a sleeve is placed in the fixture, as shown at *B*, it rests on the inner ends of four adjusting screws *C*, which are so positioned as to hold the sleeve as though in a V-block. The sleeve is located endwise by pushing it against a short vertical plug in the fixture base. Three of the indicators are calibrated to 0.0001 inch, and these show whether the outside of the sleeve is of the proper diameter at three different points. The fourth indicator shown at *D* is calibrated to 0.001 inch only, and this is used to make sure that the sleeves are not more than 0.001 inch from the specified size.

The manner in which the indicator gages are set to zero for an inspection is illustrated at *A*. Bar *E*, on which are mounted three hardened and ground master disks of the same diameter as the outside of the sleeve to be inspected, is placed in the fixture with the two end disks in contact with the inner ends of the adjusting screws *C*. With their spindles in contact with the respective disks, the indicators are then adjusted to register zero as bar *E* is revolved.

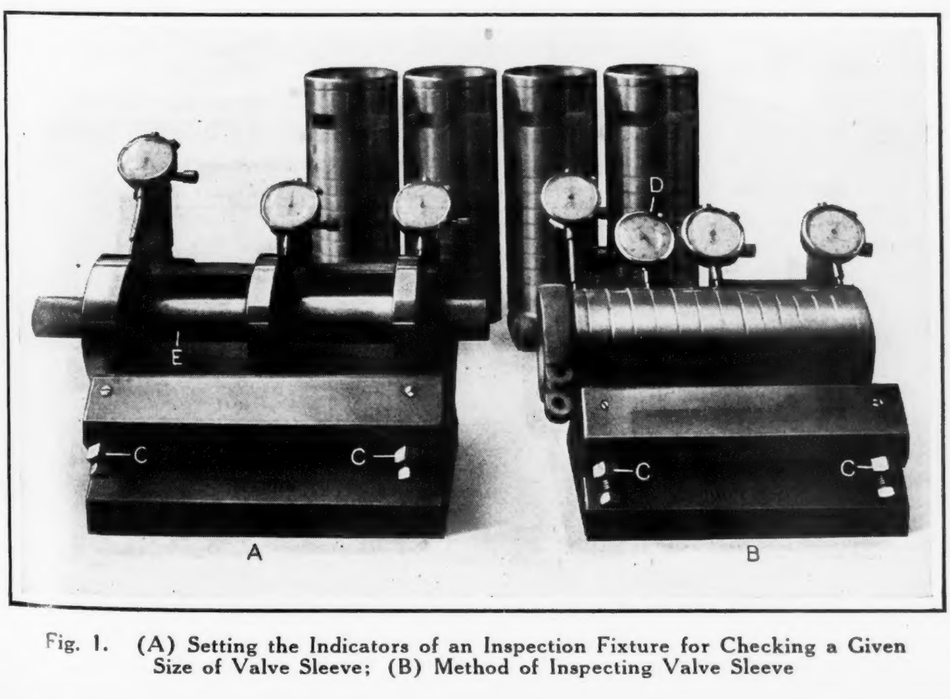


Fig. 1. (A) Setting the Indicators of an Inspection Fixture for Checking a Given Size of Valve Sleeve; (B) Method of Inspecting Valve Sleeve

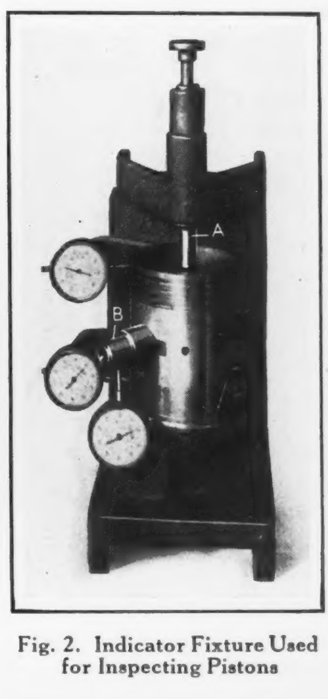


Fig. 2. Indicator Fixture Used for Inspecting Pistons

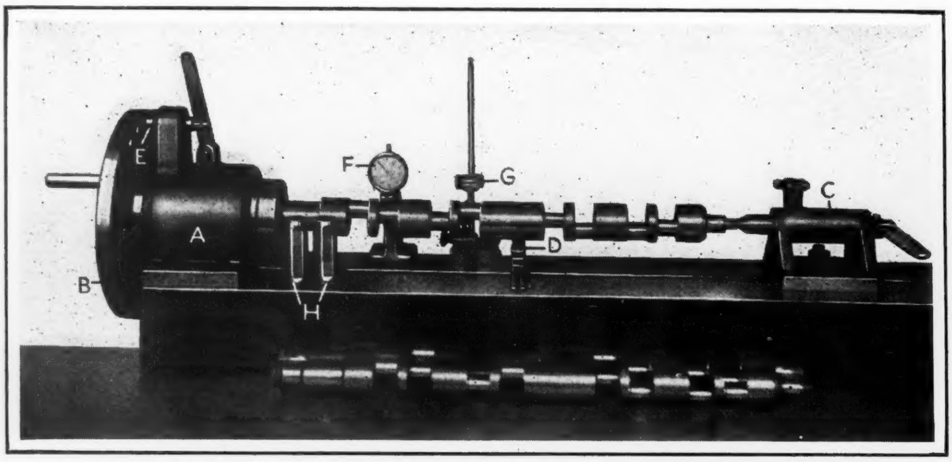


Fig. 3. Indexing Type of Fixture Employed in the Inspection of Eccentric Shafts

applied for checking the width and fillets of the pins.

Inspection of Crankcases

Crankcases are checked by means of the fixture shown in Fig. 4 after all the machining operations have been performed. The finished bottom of a crankcase rests on four hardened and ground blocks on the fixture base. The crankcase is then shifted until two dowels of the fixture enter reamed holes in diagonal corners of the flanges which extend along the bottom of the crankcase. By this method, every crankcase is positively located in the same manner.

After a crankcase has been placed in the fixture, plugs *A* and *B* are inserted in the bearings provided for the main and eccentric shafts, respectively, to check the center-to-center distance between these bearings. This distance is held to limits of plus or minus 0.001 inch. A small pin also contained in bracket *C* is employed to check the location of a dowel-hole in the crankcase, and a feeler gage is used to check the location of the crankcase end in relation to the dowel-holes by means of which the crankcase is located in the fixture.

At the right-hand end, the fixture is provided with brackets, such as shown at *D*, and plugs for checking the center-to-center distance of the bell housing holes, this distance being also held to limits of plus or minus 0.001 inch. A second feeler gage is employed at this end for checking the length of the crankcase. Brackets *E* and *F* on the front of the fixture are equipped with plugs for checking the location of pads provided for the magneto and generator brackets. Both the distance from the faces of the pads to the center line of one of the flange dowel-holes and the distance from the bottom of the crankcase to one edge of the pads are checked.

Inspecting Pistons for Concentricity and Squareness

Fig. 2 shows an inspection performed on pistons to check the concentricity of the ring grooves, the concentricity of the skirt, and the squareness of the piston-pin holes with the skirt. The skirt end is seated on a conical plug or "bell center," which can be readily rotated in order to revolve the piston past the indicators. The upper end of the piston is held by the conical end of rod *A*, which is entered into the center hole in the combustion chamber.

Plug *B* is inserted through the piston-pin holes and the vertical spindle of the lower indicator is registered with the plug to check the squareness of the holes with the skirt. The ring groove and skirt diameters must be true within 0.0015 inch, and the piston-pin holes must be square within 0.001 inch. All three indicators are calibrated to 0.001 inch.

Fixture Used in Checking Eccentric Shafts

Each eccentric pin on the eccentric shaft is inspected for the amount of throw and the plane of eccentricity in the unusual fixture shown in Fig. 3. For the inspection, one end of the shaft is inserted in the socket of a spindle held in head *A*. A Woodruff key is first inserted in a keyway in this end of the eccentric shaft, and this key is then entered into a slot in the spindle of head *A*. This arrangement insures that each eccentric shaft will be held in the same relation to disk *B* mounted on the opposite end of the spindle. The right-hand end of the eccentric shaft is supported by tailstock *C*, while rest *D* provides support near the middle of the shaft. Rotation of the work may be accomplished by turning the handle of the disk.

Disk *B* contains four index holes into which the pin of plunger *E* is successively entered to bring each of the eight eccentric pins into proper position to be checked by indicators *F* and *G*. Indicator *F* is employed for determining the plane of the eccentricity, and indicator *G* for finding the amount of throw. For a shaft to pass inspection, the errors shown by the indicators must not exceed 0.005 inch. Both indicators are mounted on bases, which can be easily shifted along the fixture bed as required. Bars *H* are employed for setting the indicators to zero for a given eccentric shaft. This equipment is employed for four different eccentric shafts.

While a shaft is mounted in the fixture, micrometers are also employed for inspecting the diameters of the bearings and eccentric pins, and gages are

How Rough Cylinder Blocks are Inspected

When the castings arrive from the foundry, various dimensions of the cylinder blocks are checked by means of the fixture shown in Fig. 5, to make

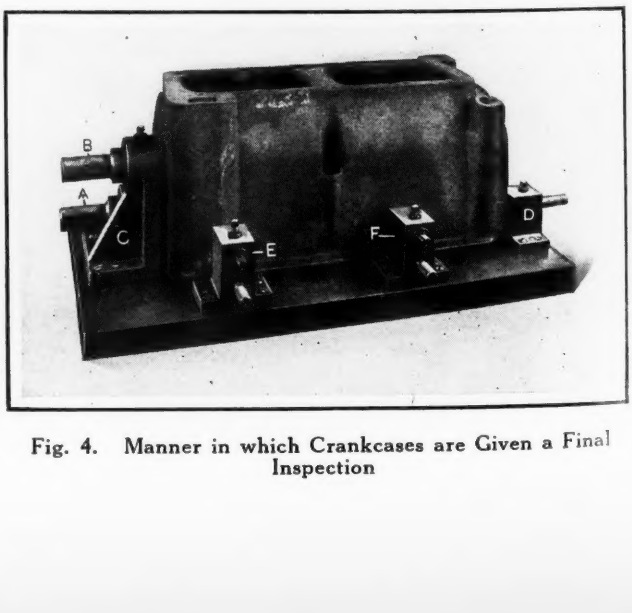


Fig. 4. Manner in which Crankcases are Given a Final Inspection

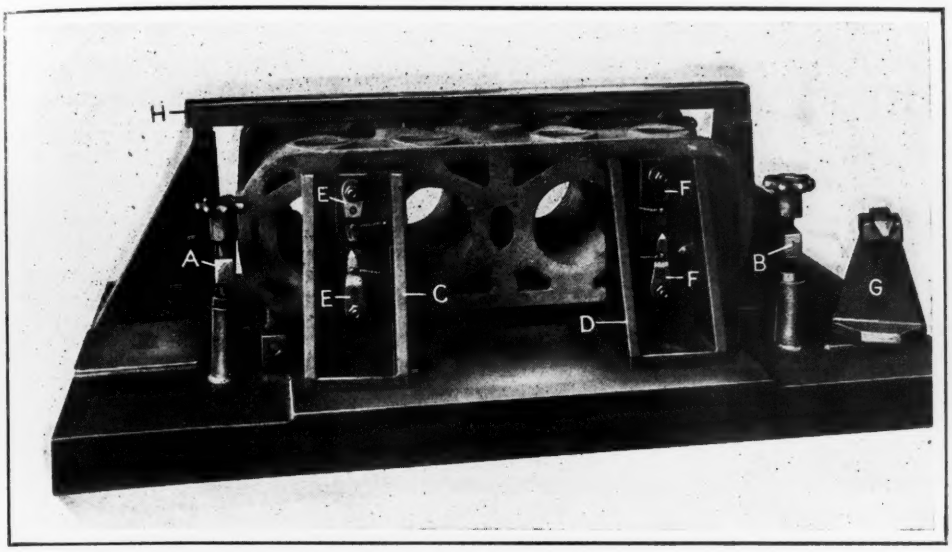


Fig. 5. How Rough Cylinder Blocks are Checked Prior to Machining

certain that the surfaces can be machined within specifications. As explained in the article "Making Yellow Sleeve-Valve Engines," which appeared in March MACHINERY, the first operation on the cylinder blocks consists of milling the top, bottom, intake side, and exhaust side in a planer type milling machine. For the first step of that operation, each cylinder block is located in a fixture by three lugs, two of these lugs being on one end of the cylinder block and the third on the opposite end. The faces of each of these lugs should coincide with the vertical center line of all four bores in the cylinder block.

When a cylinder block is placed in the inspection fixture shown in Fig. 5, the same three lugs rest on the adjustable bars *A* and *B*. It is then a comparatively easy matter to determine whether or not the various surfaces can be machined within specifications and whether the different walls will be of the desired thickness when all the operations have been completed. Brackets *C* and *D* are provided with ball-end feelers which extend through cored openings to register with the outside surface of the cylinder bore walls. The outer ends of the shafts on which these feelers are mounted are provided with pointers *E* and *F*.

If the cylinder block lugs which rest on bars *A* and *B* have faces that coincide with the center line of the cylinder bores, and the walls of the bores are correct, the two pointers of either pair on brackets *C* and *D* will be in alignment when the ball-end feelers are in contact with the bore walls. Should the pointers not be in alignment, bars *A* and *B* are adjusted up or down, as required, until alignment is obtained. The scribing tool mounted on the top of bracket *G* is then drawn along each cylinder block lug, with the bracket resting on finished pads of the fixture. This indicates the amount of stock that must be filed from the lugs to bring the faces in line with the center line of the bores, or the thickness of the shims that must be inserted under the lugs when the casting is placed in the milling fixture. By pushing brackets *C* and *D* in and out while the ball ends are in contact with the walls of the cylinder bores, the straightness of the walls can be determined.

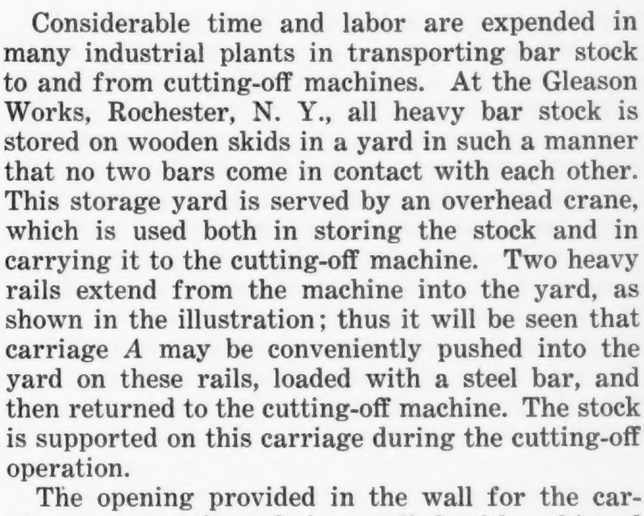
When the cylinder blocks are placed in the fixtures employed in the first step of the milling operation, two lugs on the intake side of the blocks are used as locating points to insure milling the top and bottom of the blocks in the desired relation to the port holes. Thus, when a cylinder block is placed in the fixture illustrated in Fig. 5, plugs are applied to check the position of these lugs on the casting. Bar *H* is provided with a plug which extends downward into the water intake hole and in this way indicates whether or not the wall of the adjacent cylinder bore is too high.

* * *

HANDLING BAR STOCK WITH MINIMUM EFFORT

Considerable time and labor are expended in many industrial plants in transporting bar stock to and from cutting-off machines. At the Gleason Works, Rochester, N. Y., all heavy bar stock is stored on wooden skids in a yard in such a manner that no two bars come in contact with each other. This storage yard is served by an overhead crane, which is used both in storing the stock and in carrying it to the cutting-off machine. Two heavy rails extend from the machine into the yard, as shown in the illustration; thus it will be seen that carriage *A* may be conveniently pushed into the yard on these rails, loaded with a steel bar, and then returned to the cutting-off machine. The stock is supported on this carriage during the cutting-off operation.

The opening provided in the wall for the carriage to pass through is supplied with a hinged door that may be lowered over the opening when the weather is inclement. Both rails are mounted on substantial concrete piers. In the illustration, the machine and carriage are seen through an open door. Storage stacks for pipe and the smaller sizes of bar stock are seen in the background.



Arrangement for Transporting Bar Stock Direct from Storage Yard to Cutting-off Machine

Why Some Patents Prove Worthless

By LEO T. PARKER, Attorney at Law, Cincinnati, Ohio

NOT many persons have sufficient spare time nor the inclination to digest the records of numerous patent litigations to obtain accurate information about the tested and legal methods of protecting new inventions without incurring the usual patent application expenses, particularly while the practicability of the invention is in a stage of uncertainty. The purpose of this article is to give this information, in condensed form, as based upon the outcome of actual Court decisions.

It is advisable first to have a thorough understanding of the legal status of an application for a patent, which is not, as many persons seem to believe, an absolute protection against others obtaining a patent on the invention. Moreover, even if a person files an application for a patent after another inventor obtains a patent, the Government may revoke the patent and grant one to the true inventor.

When the Government issues a patent, it does not guarantee protection of the inventor's right to the patented invention. The patent contains a statement to the effect that the patentee is given the "exclusive right to make, sell, and use the invention." However, recently one of the Courts explained the meaning of this phrase to be merely the right to exclude others from making, selling, or using the invention, after the patent has been thoroughly examined in the Courts and been declared valid. Because of the somewhat intangible and uncertain rights conferred by the granting of a patent, it is of great importance that inventors and manufacturers obtain a general idea of past Court rulings in patent matters and learn why some patents have proved worthless, though the rights of the inventor may have seemed perfectly clear to him. In the present article, Mr. Parker deals with a number of the reasons why apparently good patents may be valueless.

Who is the Original Inventor?

When the Government issues a patent, it guarantees practically nothing. The patent contains a statement to the effect that the patentee is given the "exclusive right to make, sell, and use the invention." However, recently a Court explained the meaning of this phrase to be the right to "exclude" others from making, selling, or using the invention after the patent is thoroughly adjudicated in the Courts and is declared valid.

The law is well established that a patent is intended to be issued to the "original" inventor of the thing patented. In this respect, the word "original" has a very broad and comprehensive meaning. In other words, for a patent to be valid, the patentee must have been the first one in the whole world to put the invention into practical usage; although there is one distinction, in that a simple use, without publication, in a foreign country will not bar an American inventor to a patent.

However, many persons are under the impression that a valid patent need only relate to an invention that is new in the United States. For this reason, the term "valid patent" has a distinctive meaning also.

When Invention has been Described Previously

To illustrate, when an application for a United States patent is filed, the customary drawings, specification, petition, oath, and first government fee of $20 is sent to the Patent Office at Washington. After this application has remained in the Patent Office for a period of time sufficient for the official examiners to have acted on previously filed cases, it comes up for consideration.

The examiner in whose division the invention is classified studies the specification, claims, and drawings. He then begins a search, in an endeavor to discover a previously issued United States or foreign patent. If he fails to find one, the scientific records, mechanical magazines, and other publications are examined, because whether or not the same invention has been patented by another inventor, if a description of it has been published in this or any foreign publication, prior to the invention or discovery, or more than two years prior to filing the application, the applicant cannot obtain a valid patent. On the other hand, if the Patent Office examiner fails to make a thorough search of the various previously issued patents and prior publications of the world, he may not discover a previous invention; consequently, the inventor receives an invalid patent.

The patent is merely a certificate from the Government that permits the inventor to legally enter a Court and demand damages and profits, if he believes another person is an infringer by either making, selling, or using the invention. No doubt if the individual being sued has the required amount of money, he will engage the services of a competent attorney or specialist in patent laws. If after a careful comparison of the "claims" with the device thought to be an infringement, the attorney believes the device actually infringes the claims of the patent in question, the counsel probably will institute a wide and thorough search to find a publication of the invention that may have been overlooked by the Patent Office examiner.

If the attorney is successful in discovering that which the examiner failed to find, the new information is presented to the Court as evidence that the patent was improperly issued and is invalid. Under these circumstances, the patent is worthless, and the inventor may not prevent others from making, selling, and using the invention.

Two Years Public Use Bars Patent

It is plainly evident that a patent has no certain or dependable value until it has passed the gauntlet

of the Courts, and even then there is a chance that proof of an old and unknown invention might be brought to light, as a result of which the patent may be declared void and of no effect. For example, in a quite recently decided case, it was disclosed that an inventor who had obtained a patent on a valuable machine improvement, instituted legal proceedings against a manufacturer who was making and selling the invention without a license. During the litigation the manufacturer introduced evidence to show that the device had been manufactured and sold many years previous to the time the patentee invented it. In view of this circumstance, the Court held the patent void, and the manufacturer was not compelled to pay royalties for the privilege of making the product.

When another person has invented a thing and put it into actual practice before the individual who obtained the patent, the first inventor is entitled to the patent, provided the invention has not been in public use or on sale for more than two years. In the latter instance, the holder of the patent, being the second inventor, would possess an invalid patent, and the first inventor would be barred from obtaining a patent.

For illustration, in a recent litigation it was disclosed that two widely separated inventors had worked to perfect the same invention. One perfected it and offered it for sale for a period of three years without obtaining a patent. Later the other inventor applied for a patent, and then the first inventor decided to obtain the patent; but neither could secure one because of the fact that the device had been on sale for more than two years.

The records of another litigation disclose the fact that two inventors were working at the same time and unknown to each other, to perfect the same invention. One of them perfected it and built a model that operated successfully, but he was financially unable to file an application for a patent. Several months after this inventor had built the model, the other inventor perfected the invention and filed an application for a patent. A few months afterward the inventor who built the model obtained financial aid, and also filed an application for a patent. Lengthy litigation resulted, as each inventor wanted to obtain the patent, but finally it was granted to the individual who had last filed the application, but had perfected and made the model.

Protection Without Filing Application

With a knowledge of the foregoing facts, it is evident that there is a way to safeguard inventions and obtain priority rights without filing an application for a patent immediately after an invention is conceived or perfected. However, the adopted method should conform to the outcome of previously decided cases, to prevent loss of rights.

It is interesting to observe that so many persons have the "hearsay" idea that a written description of an invention may be "stored" away as a means of protecting the first inventor against another person inventing and obtaining a patent; but the records of many past litigations show that this method cannot be relied upon to effect priority rights.

For illustration, it was recently disclosed that an individual perfected an invention, drew the plans, wrote the description, and then deposited the papers in a safety vault. Several months later another inventor filed an application for a patent on the same thing. The first inventor heard of this, and immediately filed an application claiming priority rights as evidenced by the drawings and other papers. However, the Court held that the patent should be granted to the second inventor, and in effect, said that any person who secretes his invention contributes nothing to the public. And, further, since the patent laws are intended to promote inventions, the inventor who hides his invention may not lie in wait for one who independently and in good faith proceeds to disclose the invention to the public.

Inventor Must Offer Invention to Public

When an inventor makes his invention and offers it for sale, he may apply for and obtain a patent any time within two years, even though some other person files an application and obtains a patent, because the Courts hold that when an inventor, who fails to file an application for a patent, proceeds to make and sell, or offer his invention for sale, he is benefitting the public and is entitled to the same rights to obtain a patent as if he filed an application at the time the device was made, or reduced to practice.

An important decision was recently rendered (285 F 966), in which it was disclosed that one man (A) filed an application for a patent on a machine in February, 1917, several months after a patent was issued to another man (B) in September, 1916. In deciding that the patent possessed by B should be revoked and given to A, the Court explained that although A did not file an application until after a patent was issued to B, the evidence disclosed that A had perfected the invention in 1914, and proceeded at once to negotiate and advertise the machines for sale, thereby making it known to the public that he was ready and willing to give the public the benefit of the invention whenever it was practical for him to do so.

It was claimed by B's attorney that as A had failed to either file an application or make one of the machines, he was not diligent, and therefore did not deserve a patent in preference to B, who proceeded to obtain one. Ordinarily such neglect on the part of an inventor would effect the loss of his rights, but in this instance, the Court held A diligent, and said, "To actually reduce the invention to practice it would have been necessary to build and erect a press and provide a motor in it. This would involve a great outlay of money and loss of time, and after doing it, the machine would have to be dismantled before shipping it . . . The mere fact that to reduce it to practice was a work of magnitude might not be sufficient to excuse his delay, if he did not have the contract (to sell a machine), but with the contract we believe that he was fully justified in waiting."

The important thing in this case is that an inventor who had failed to apply for a patent or build a machine was held to have rights superior to a later inventor who was diligent in filing an application and securing a patent. As previously stated, ordinarily an inventor cannot step in and ask for the patent awarded a later inventor, unless it can be

proved to the satisfaction of the Court that the earlier inventor has actually built the invention and reduced it to practice. Therefore, the law is recently established that an inventor who invents a large machine and obtains an order, or contract of sale for one, need not construct it or apply for a patent until the buyer is ready to receive and install it, after which the inventor may apply for a patent and go so far as to have another patent on the same mechanism revoked.

In another quite recently decided case, the Court, in effect, held that where two persons file applications for patents on the same invention, it is incumbent on the one who last files his application to establish beyond a reasonable doubt that he deserves the patent in preference to the one who files the first application. In other words, the one who first gets his application into the Patent Office is not compelled to disprove the case, but the other must introduce convincing testimony to obtain the patent.

* * *

THE VALUE OF SHOP EXPERIENCE TO THE DESIGNER

By HAROLD R. GOODRICH

The applicant for the position of designer in the average engineering department of an industrial concern seldom realizes that lack of shop experience may be considered a serious drawback. In fact, it is doubtful if the majority of chief draftsmen actually appreciate the true value to designers of a thorough knowledge of, or familiarity with, modern shop methods.

The purpose of this article is to furnish a few points for serious thought, based on the belief that the designer who has acquired a working knowledge of modern shop practice will do his work more efficiently and with more economical results. Economy must be kept in mind from the time an article is invented until it has been placed in the hands of the user.

Designing to Facilitate Production

No one will dispute the fact that almost any mechanism can be worked out to the most minute detail by competent designers with practically no thought of the shop facilities available for its production. On the other hand, it must be admitted that the cost of production would be reduced if consideration were given by the designer to the question of how the various parts could be most economically manufactured and assembled in the shop.

Nearly every machinist can recall numerous cases where a slight change in the design of a piece has materially lowered the machining expense. While these changes may eventually be made, the cost could be greatly reduced if the original design had been made with the shop production possibilities in mind. The writer believes that the total expense entailed by these changes, over a year's time, reaches an astonishing figure even in the small shop.

While few parts call for finished surfaces that are impossible to machine in some manner, there are innumerable instances where difficult machining operations can be materially simplified without sacrificing the efficiency of the part in question. In the case of parts requiring several different operations, the knowledge of how to perform these operations in the most economical sequence, and how to maintain this order through the shop, would certainly prove a valuable asset to the designer. This shop experience is essential to the tool designer, as he is constantly confronted with the problem of obtaining efficient machining conditions.

Capacity of Machine Tools Should be Known

Large numbers of jigs and fixtures are being designed and made in shops today that are entirely inadequate to withstand the application of the high speeds and heavy feeds now demanded. If the tool designer is to provide for wear and tear on the tools, he must acquaint himself with the actual operating conditions of different types of machines. In many cases, users of high-speed machine tools are still unaware of the actual capacity of the new machines that are rapidly replacing their old equipment.

Many men who are now obtaining actual shop experience are also receiving technical instruction in the class room. These men will be qualified to serve as first-class designers. They will readily see the advantage that their actual contact with shop problems has given them over the purely book-trained man. There is no question that some of the best designers of tomorrow will be the shop men of today, who are also attending shop classes. Some day they will point with pride and satisfaction to their period of contact with shop work.

The ideas suggested in this discussion have been gleaned from several years of actual contact with the conditions involved, and are believed to be worthy of consideration by anyone contemplating a possible connection with the designing profession, and also by those who are now in a position to employ men for this class of work.

Shop men of today who are looking ahead to the designing field would attach more importance to their present duties, if they realized the advantages this training would give them when their goal was reached.

* * *

OUTPUT OF AUTOMOTIVE INDUSTRY

Statistics now available covering the entire year of 1926 show that 3,950,000 passenger cars, 530,000 trucks, and 15,000 motor buses were built that year. Of the passenger cars, 2,926,000, or 74 per cent, were closed cars. The wholesale value of the cars exceeded $2,600,000,000, and of the trucks $430,000,000, so that the wholesale output of the industry exceeded $3,000,000,000. In addition, 63,000,000 tires were manufactured at a value of $775,000,000, and parts and accessories for replacement were made at a wholesale value of $600,000,000. The average retail price of passenger cars was $866, and of trucks, $1090. At the present time, 3,500,000 people are employed in the motor vehicle and allied lines. Of the total output, 12 per cent was exported, the exports from United States and Canadian ports numbering 550,000 cars and trucks, valued at $475,000,000. The number of automobiles imported into the United States was only 820.

Knurling for Light Press Fits

Application of Knurled Bearing Surfaces in Assembling Parts of Small Mechanisms

By J. K. OLSEN, Chief Draftsman, Stewart-Warner Speedometer Corporation, Chicago, Ill.

READERS of MACHINERY are familiar with the use of knurled surfaces to provide a better grip on handles, caps, nuts, etc., or to secure an ornamental effect, but the application of knurling in assembling small parts is not so well known. Knurling, however, can be used to advantage in the manufacture of many classes of light mechanisms in which small stampings, pinions, or similar parts must be assembled on their shafts or rods by pressing the parts together. For example, assume that a small die-cut pinion having a drawn hub is to be assembled on its shaft. In applying the method to be described, that part of the shaft over which the pinion hub is to fit is first knurled, and then the pinion is pressed over the knurled surface.

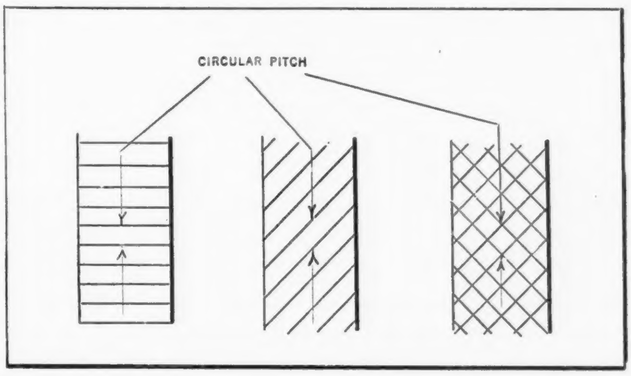


Fig. 1. Diagrams Showing how the Circular Pitch of a Knurl is Measured

The advantage of knurling is that it raises ridges or points, and thus increases the shaft diameter sufficiently to allow for larger limits between the shaft and hole diameters than would be practicable if the parts were pressed together without knurling, the bearing surfaces being plain. Furthermore, the knurling method of assembling light parts tends to avoid the cracking of bushings, hubs, etc., which might occur in assembling plain bearing surfaces, assuming that ordinary production limits are allowed. Some examples from practice will be given later to show the application of knurling and how the sizes are determined for securing the proper fit.

Classes of Knurls and Pitch of Knurled Surface

There are various kinds of knurled surfaces, but the common styles are the plain straight knurling and the diamond knurl. The former consists of grooves and ridges that are parallel to the axis, as shown at the left in Fig. 1, whereas the method of producing diamond knurling is clearly illustrated by the right-hand diagram. There are also a number of special knurls. The plain or straight knurl, however, is the kind employed ordinarily in connection with light press fits, so that the special classes will not be considered at this time.

Common Pitches for Knurling, Theoretical Depths and Minimum Diameter Increases Due to Knurling Operation

Pitch	Circular Pitch	Theoretical or Full Depth of Knurl Teeth	Minimum Diameter Increase Due to Knurling
16	0.0625	0.0445	0.0180
20	0.0500	0.0357	0.0140
24	0.0416	0.0297	0.0110
30	0.0333	0.0237	0.0090
32	0.0312	0.0222	0.0080
36	0.0277	0.0197	0.0075
40	0.0250	0.0178	0.0070
46	0.0217	0.0154	0.0060
50	0.0200	0.0142	0.0056
60	0.0166	0.0118	0.0047

Machinery

Knurls are made in a series of pitches, the pitch, according to common usage, representing the number of ridges or teeth per inch of circumference. The circular pitch, on which the number per inch is based, is measured at the outside diameter of the knurl and in a plane perpendicular to the axis of the knurled part, as indicated in Fig. 1. The most common pitches are close to the pitches employed for standard screws. The accompanying table gives some of the more common pitches and the theoretical dimensions for circular pitches and tooth depths. The last column to the right gives the minimum increase in diameter due to knurling. The application of this table will be explained later in connection with some examples. The teeth or knurls represented by this table have an included angle of 70 degrees, which is the angle commonly used for machine steel. For comparatively hard steel, the angle is generally 60 degrees, whereas for brass it is 90 degrees.

Increase in Diameter due to Knurling

When knurled surfaces are used for light press fits, instead of plain surfaces, it is essential to know how much the diameter of the shaft, or whatever external part is to be knurled, will be increased by the knurling operation, in order to make proper allowance for the press fit. The theoretical dimensions for the depths of perfectly formed teeth, as given in the third column of the table, should not be used in determining the increase in diameter of a knurled part, because in actual practice, teeth of full depth are not formed. Thus in producing a knurled part, say, on an automatic screw machine, the time for knurling may not be sufficient to form perfect teeth; moreover, the strain due to knurling causes some springing action, and consequently the actual depth of the teeth or knurls is considerably less than the theoretical dimension.

If 40 per cent of the theoretical depth is add-

ed to the shaft diameter, then the minimum increase in diameter due to knurling will be obtained close enough for practical purposes. The last column to the right in the table gives dimensions that are 40 per cent of the theoretical dimensions in the preceding column; hence, the last column gives the amounts to add to the shaft size to obtain the minimum diameter as measured over the knurled surface. This minimum dimension, then, is used as a basis for determining the size of the hole, as will be explained. (It will be understood that the use of 40 per cent of the depth is equivalent to 20 per cent increase on each side of the shaft.)

Example of Knurling for Light Press Fit

The small pinion and shaft shown in Fig. 2 is a typical example of the use of knurling in connection with assembling. The pinion is produced in a die from sheet metal, and the hub is drawn, as the illustration indicates. As previously mentioned, straight knurling is preferred, because the parallel ridges on the shaft will form shallow grooves in the pinion hub (if the latter is not hardened) which assists in preventing any twisting action or rotation of the pinion on its shaft.

The diameter of the shaft before knurling is $0.203 \begin{matrix} +0.002 \\ -0.000 \end{matrix}$ inch. In this case, the knurl has a pitch of 40, and as the table shows, the diameter increase for this pitch is 0.007 inch, as given in the column at the extreme right; consequently, the minimum diameter after knurling equals $0.203 + 0.007 = 0.210$ inch. The minimum and maximum limits for the hole in the hub, in this case, are 0.205 and 0.207 inch; hence, the difference between the minimum shaft diameter, or 0.210 inch, and the maximum hole diameter, or 0.207 inch, equals the minimum allowance for the press fit, which is 0.003 inch.

The maximum allowance may be determined by assuming that the shaft has a perfect knurl, or one

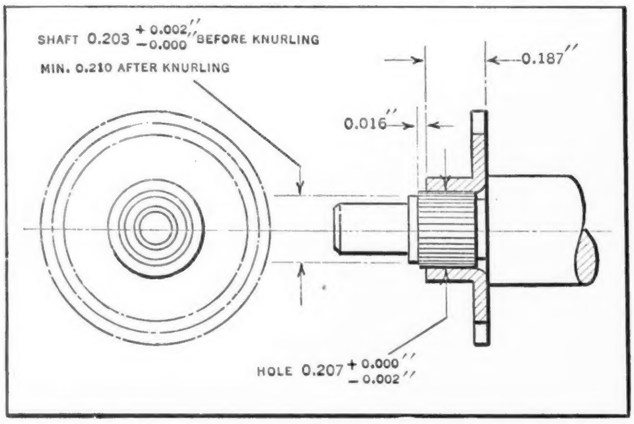


Fig. 2. Small Pinion Having Drawn Hub, Pressed on Knurled Shaft

of full depth, although in practice, this is not likely to be the case. The full or theoretical depth, in this instance, for a 40-pitch knurl is 0.0178 inch, which, added to the maximum shaft diameter before knurling, or 0.205 inch, gives a possible outside diameter after knurling of 0.2228 inch. The difference between the latter amount and the minimum hole size, or 0.205 inch, equals the extreme press fit allowance, which is 0.0178 inch.

It is, of course, comparatively easy to assemble parts when one of the bearing surfaces is knurled, because the contact is with ridges instead of plain bearing surfaces. For this reason, it is quite likely that the drawn pinion and its shaft will assemble without cracking, even if there should be the extreme press fit allowance of 0.0178 inch. If a tighter fit should be required between the pinion and shaft, the press fit allowance may be increased either by increasing the diameter of the shaft or by using a knurl of coarser pitch, assuming that a large number of turned shafts are on hand.

For the parts shown in Fig. 2, a "Go" and "Not Go" gage are needed for the shaft diameter before knurling, and a "Not Go" gage after knurling, together with inspection to insure that the pitch of the knurling is correct. In addition, there should be a "Go" and "Not Go" plug gage for the hole in the pinion. These four gages should insure proper assembly.

When Drawn Pinion Hub is Used

The pinion shown in Fig. 2 is made with a drawn hub, because the thickness of the stock without this hub would be insufficient to provide a satisfactory press fit. This construction would be objectionable if a more compact design were required or if the pinion teeth had to have wide bearing surfaces. The drawn hub design, however, is cheap and satisfactory for medium sized parts that can be assembled permanently. For larger gears, however, and for most spiral gears or wide gears, the gear teeth

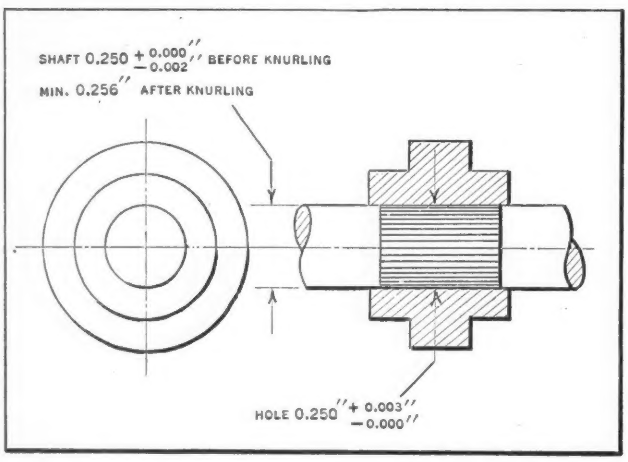


Fig. 3. Brass Collar Pressed on Knurled Section of a Steel Shaft

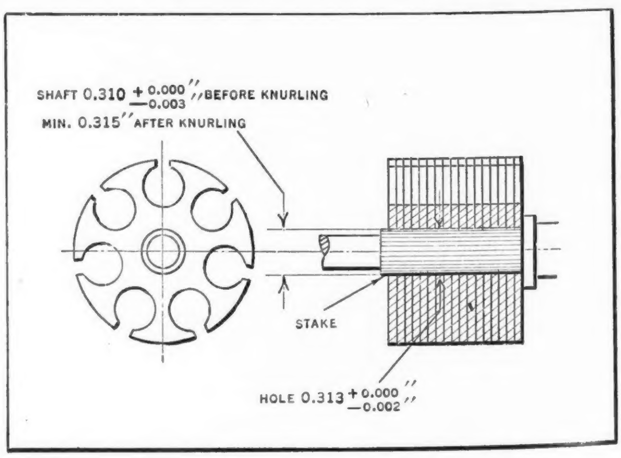


Fig. 4. Use of Knurled Shaft for Laminated Core Construction

should be cut directly into a part of the solid shaft whenever possible.

If an attempt were made to avoid the drawn hub (Fig. 2) by using thicker stock to obtain a wider bearing surface on the shaft, this might necessitate cutting the gear teeth by milling or hobbing, instead of using a die, which would reduce production and increase cost. While it would be possible to use a plain punching for the gear, and replace the hub with a separate bushing as a reinforcement, this would necessitate an extra screw machine part, again increasing the cost. Incidentally, if additional strength should be required in assembling such parts as shown in Fig. 2, it might be advisable to harden the shaft; then the knurled portion would form deeper grooves in the hub, assuming that the latter were not hardened.

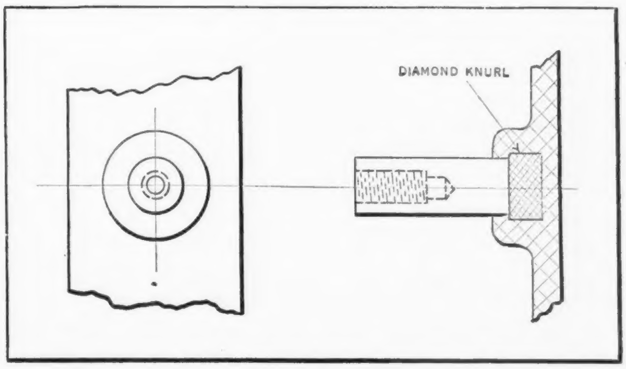


Fig. 5. Composition Cast about Knurled End of Stud

Brass Collar Fitted to Steel Shaft

Another application of knurling in connection with a light press fit is shown in Fig. 3. In this case, a drilled brass collar is pressed on a steel shaft made from standard cold-drawn stock. The size of the shaft or rod before it is knurled is $0.250 {+0.000 \atop -0.002}$ inch.

In determining the pitch of the knurl for work of this kind, the flexibility of the shaft must be considered, because if a coarse knurl is applied to a slender shaft, the latter may be deflected too much by the knurling operation. In this instance, a knurl having a pitch of 32 and a width of 3/8 inch is selected. The outside diameter of the shaft after knurling equals the minimum shaft diameter or 0.248 inch, plus 0.008 inch, which, as shown by the table, is the minimum amount of increase in diameter for a knurl of 32 pitch; hence, the minimum outside diameter after knurling equals 0.256 inch.

This brass collar is a drilled part. If the hole were drilled to full size in one operation, a variation in size of, possibly, 0.006 inch might be expected. This would be excessive, however, because the minimum increase in shaft diameter (above the maximum size) after knurling is only 0.006 inch; hence, to avoid special reamer equipment, the hole is first drilled under size and then finished by redrilling. With this method the tolerance should be held within about + 0.003 inch. The first drill is a D size (0.246 inch), and this is followed by the 1/4-inch size. Since the minimum shaft size after knurling is 0.256 inch and the maximum hole size 0.253 inch, the minimum allowance for a press fit is 0.003 inch. This allowance under average conditions should be satisfactory, as in this case there is a long bearing surface in proportion to the size of the parts.

Other Examples of Knurling

A laminated core, such, for example, as a small motor armature, may be mounted on a knurled shaft, as illustrated by the example shown in Fig. 4. In this instance, the shaft size before knurling is $0.310 {+0.000 \atop -0.003}$ inch, and as a 32-pitch knurl is used, the minimum size after knurling is 0.315 inch. The minimum shaft size of 0.315 inch minus the maximum hole size, or 0.313 inch, equals 0.002 inch, which is the minimum press fit allowance.

In assembling a series of laminations on a shaft, the tendency is to gradually reduce the shaft size owing to wear as successive laminations are pressed on; consequently, the last lamination will have only a light fit so that it should either be "staked" or else reinforced by an additional collar having a smaller hole. The staking operation consists in merely indenting with a pointed tool the lamination and shaft, thus forming a crude key.

Straight knurling with ridges or grooves parallel to the shaft axis is employed for all the opera-

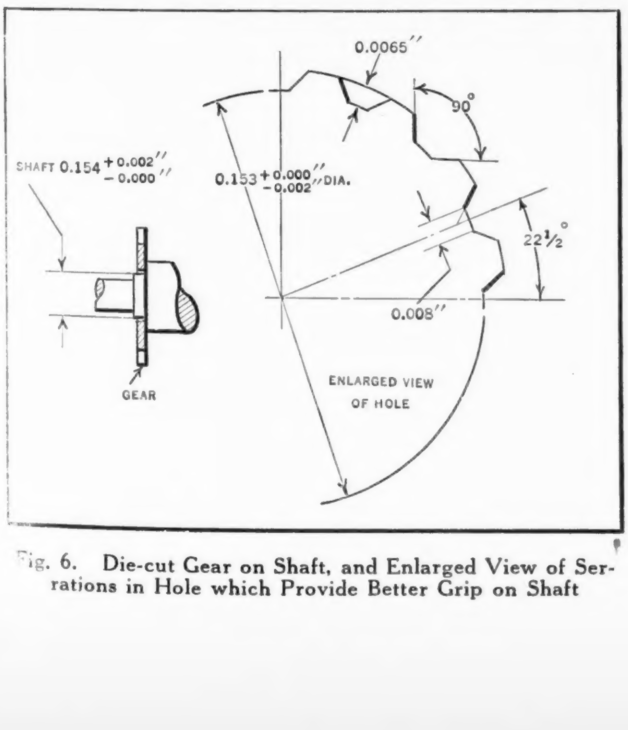


Fig. 6. Die-cut Gear on Shaft, and Enlarged View of Serrations in Hole which Provide Better Grip on Shaft

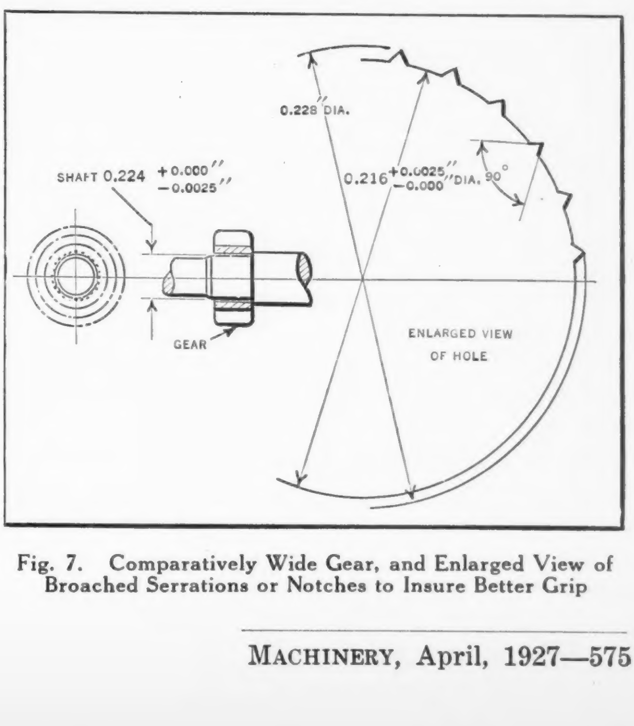


Fig. 7. Comparatively Wide Gear, and Enlarged View of Broached Serrations or Notches to Insure Better Grip

tions previously mentioned. A diamond knurl, however, is preferred to the straight knurl for the particular part shown in Fig. 5. A composition is cast about the knurled end of a stud. The composition, of course, fills the spaces between the knurled ridges, so that the stud is held more firmly. This method of construction is used mostly to reinforce metal parts embedded in bakelite and in die-castings.

Use of Serrated Hole Instead of Knurled Shaft

When a hardened pinion, collar, or other part is pressed on a shaft, a serrated hole in the external part is more effective than knurling on the shaft itself, especially if the shaft is not hardened. The teeth or serrations that are formed around the hole, as indicated by the diagram Fig. 6, form grooves in the shaft when the two parts are assembled, thus providing a tight grip.

Fig. 6 shows, at the left, a small gear that has been assembled on its shaft in this manner, and at the right there is an enlarged view of the sixteen notches or serrations that have been cut in the hole of the gear. The gear teeth and these notches are blanked out in one operation. It will be noted that the teeth or serrations have flat points. The press fit allowance at the points of these teeth ordinarily varies from 0.001 to 0.005 inch, a light fit usually being desirable, as an excessive allowance would damage the serrations; in fact, the full circumference of the hole is never used for the press fit. It is not always necessary to harden the gear, especially if the parts are small and not subject to rough handling or operation.

Shape of Serrations

There are no fixed rules for determining the shape, size, or number of the serrations, because the size and function of the parts should be considered. It is good practice to use the flat form illustrated in Fig. 6 in preference to sharp points, as these flats provide a gaging surface and a more definite bearing surface for the fit. When a gear is die-cut, the serrations and the gear teeth can be blanked at the same time, so that the extra operation required for a knurled part is eliminated.

If a gear or pinion is comparatively wide, as shown by the example in Fig. 7, the hole is finished to size and the serrations formed by broaching. This kind of gear is made on an automatic screw machine, and is used where a wider tooth bearing surface is required than would be obtained with a die-cut gear.

In this example, the maximum hole diameter is 0.228 inch and the inside diameter of the hole is $0.216 \begin{smallmatrix} +0.0025 \\ -0.000 \end{smallmatrix}$ inch. The diameter of the shaft is $0.224 \begin{smallmatrix} +0.000 \\ -0.0025 \end{smallmatrix}$ inch; hence, the minimum press fit allowance is 0.003 inch and the maximum allowance is 0.008 inch. If a plain hole and shaft were used in this case, a maximum of 0.008 inch would be an excessive allowance, but when serrations are used in the hole, the parts may readily be assembled.

The foregoing examples of knurling and serrations as applied to the assembly of parts of light mechanisms have been taken from actual practice, and they may be used as a general guide in designing other knurled and serrated parts, since the procedure is quite similar, even though the sizes and shapes of the parts may differ considerably. In press fits on work of this general class, a somewhat rough surface is preferable to a highly polished surface, as it results in a better fit.

The use of knurled and serrated surfaces in connection with light press fits has been used to advantage on various classes of light mechanisms, such, for example, as speedometers, telephone apparatus, radio mechanism, electrical instruments, carburetors, lubrication equipment, small motors, warning signals, and similar apparatus.

* * *

MACHINE SHOP MEETING IN CHICAGO

The Chicago section of the American Society of Mechanical Engineers held its spring machine shop practice meeting March 16 at the Machinery Club, 649 W. Washington St. The program included four papers and two industrial motion pictures. At the afternoon session a motion picture was shown of the manufacture of watches at the Elgin National Watch Co., Elgin, Ill. Afterward A. Langsner, chief engineer of the Eugene Dietzgen Co., spoke on "Changing Manufacturing Methods to Reduce Costs"; and E. F. Smith, district sales manager of the Haynes Stellite Co., spoke on the subject "Stelliting of Metal Parts Subjected to Wear."

At the evening meeting a motion picture "From Mine to Consumer," produced by the American Brass Co., showed the mining of the constituent metals in brass and the methods used in brass manufacture. At the same session papers were read by Ernest F. DuBrul, general manager of the National Machine Tool Builders' Association, on "The Engineer's Contribution to the Growth of Machinery," and by W. W. Nichols on "Automatic Feeding Devices for Machine Tools."

* * *

GAGE SECTION OF BUREAU OF STANDARDS

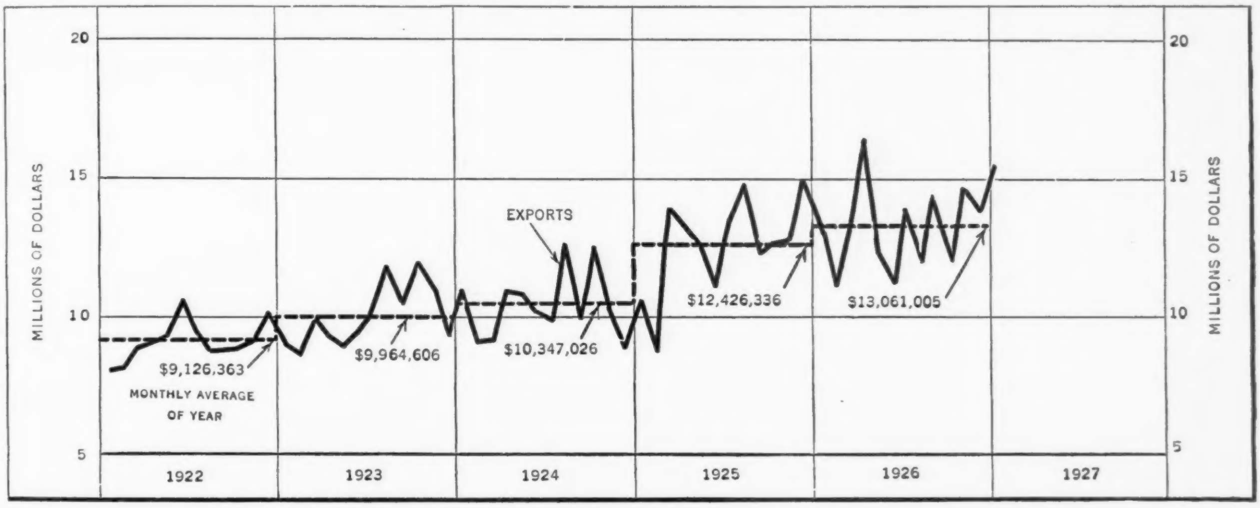
In the annual report of the Bureau of Standards, attention is called to the important work done by the Gage Section of the bureau. In this connection, the report mentions the importance of gages in interchangeable manufacture, quoting the following representative examples: The production and inspection of the Springfield Army rifle requires the use of 1263 gages; a machine gun about 2200 gages; and one make of automobile about 15,000 gages. The Ordnance Department of the War Department has under its charge in the various arsenals more than 500,000 gages, the replacement value of which is about $30,000,000.

Obviously, the Bureau of Standards or any other single organization could not hope to test all or even a large proportion of the limit gages in use in the manufacturing industries of the country. Fortunately this is not necessary, since each manufacturer can, through the use of certified standards, be largely responsible for the accuracy of his own gages and product. It is desirable, however, for all manufacturers and users of gages to have access to the same ultimate standards. This means is provided by the Gage Section of the Bureau of Standards.

The Machine-building Industries

THE seasonal decline in business referred to in this review for the last two months has passed, and an improvement in most lines of business may now be recorded. From a survey of forty-eight lines of business made by *Bradstreet's*, we find that eleven lines are doing a bigger business than during the same period last year, twenty-eight are doing an equal amount of business, and only nine are doing a smaller business than a year ago. The building industry, which is one of the cornerstones of the business structure, is continuing to show great activity, automobile production is improving, and the iron and steel industry—the basic industry in the entire engineering field—is almost, if not fully, as active as at this time last year. Railroad freight movements are greater.

Briefly, every indication points to a year of about the same activity as 1926. The more conservative forecasters say "Business will possibly be less than in 1926, but most certainly greater than in 1925."



Department of Commerce Chart Showing Exports of Industrial Machinery from the United States, 1922-1926

Improvement is Noticed in the Machine Tool Industry

According to information obtained from Ernest F. DuBrul, general manager of the National Machine Tool Builders' Association, the demand for machine tools, as shown by the association's index of machine tool orders, improved slightly during February, responding to a similar improvement in the iron and steel and the automobile industries. The improvement in the machine tool field during February continued with most manufacturers during March. A good demand has been noticeable in the grinding machine and gear-cutting machinery fields especially. The demand for heavy machinery has also improved. The automobile industry, as usual, asks for quick deliveries, making up its mind to buy only as immediate requirements demand new equipment.

The forging machinery business has been quite active, although the railroads, among the largest users of several types of forging machines, are not yet buying to any considerable extent. Many instances are mentioned where railroad shops have had these machines, as well as other lines, rebuilt at considerable expense, when new machines could have been bought at almost the same figure; but because of governmental regulations that hamper the railroads in exercising their best judgment in matters of this kind, they are free to spend whatever they wish on repairs, but are not able to spend as freely on new equipment.

Small Tool Business Shows Gain

The small tool industry is gradually coming back to the level of last fall, after having been affected by the reduction of automobile production schedules during the winter months. In the twist drill field, prices are still very low, and only by large production and improved methods are manufacturers able to make a profit at present prices. The metal-cutting saw business has maintained a fairly high level for the past year.

In the hacksaw field there has been a considerable improvement. After five years of ruinous competition, which meant the selling of hacksaws at a loss—prices being below the pre-war level—there has been a gradual rise in prices, so that at present manufacturers are able to meet their costs.

Exports of Industrial Machinery Increase

Exports of industrial machinery during January, the last month for which complete statistics are available, amounted to nearly $15,000,000, as compared with $13,435,000 for the corresponding month of 1926. The accompanying chart indicates the monthly exports of industrial machinery from the United States since 1921.

Shipments of metal-working machinery amounted to $1,847,560, nearly $191,000 more than for January, 1926. Exports of cylindrical grinding machines rose from $53,600 to $139,800; of forging machinery, from $71,600 to $106,000; and of foundry equipment, from $42,700 to $134,100.

Current Editorial Comment

in the Machine-building and Kindred Industries

THE NEW INFANT INDUSTRY

Manufacturers of shop equipment are watching with considerable interest our rapid progress in air transportation. At the beginning of this year there were more than 1200 modern airplanes in commercial use in the United States, of which 636 were built last year. A much larger number will be built during 1927. There are thirty-nine manufacturers of airplanes and engines, and as this industry develops, it will demand adequate and suitable machine tool and other shop equipment. While commercial aviation has not developed in America as rapidly as in Europe, it is safe to predict that when it finally becomes an accepted means of transportation in this country, very rapid progress will be made, and the manufacture of airplanes and airplane engines will become one of the really important industries of the country.

* * *

COOPERATIVE INSPECTION METHODS

With the development of quantity production methods came the necessity for a more highly developed inspection system than formerly had been needed. In small shops, and often in larger shops where only small quantities of any one part are made, the workmen are frequently required to act as their own inspectors—that is, they are depended upon to see that the parts are made in accordance with the drawings and specifications.

In quantity production shops, as a rule, it is not economical to have the workman act as inspector of his own work, for an expensive machine would often stand idle while the workman was measuring and gaging the product. This makes necessary separate inspection departments, where all parts are inspected and those that do not meet the requirements are rejected. But when this system was first applied, the results obtained were not altogether satisfactory. The inspector considered it his duty to reject everything that was not according to the requirements, but did not fully understand his relation to the economic management of the plant. He thought it his duty to reject inaccurate and defective products, irrespective of the effect upon the output of the shop and the cost of manufacturing.

Recently a much closer cooperation between the inspection and the production departments has been encouraged in many manufacturing plants. The inspectors are made partly responsible for a high percentage of rejections, as it is their duty to prevent defective work from passing through the shop by immediately suggesting the adoption of remedies, instead of waiting until a large lot has been manufactured to incorrect dimensions. The new scheme requires the inspector to gage, at certain intervals, the parts being made, at the machine where they are produced. Then, if due to worn tools or some other defect in the machine or tooling equipment, inaccurate pieces are being produced, the trouble can be remedied immediately, instead of waiting until thousands of parts have been brought into the inspection department.

In this way, the manufacturing and the inspection departments are brought into close cooperation, and the amount of rejected material is reduced to a minimum. It may be said that this is only the obvious, common sense, method of inspection—and so it is; but it took industry a long time to develop inspection methods that remedied defects as soon as something went wrong.

* * *

TOLERANCES ON DRAWINGS

Considerable confusion is caused by the different methods used for indicating tolerances or limits on drawings, and it is unfortunate that no universally accepted standard exists for dimensioning drawings when tolerances are given.

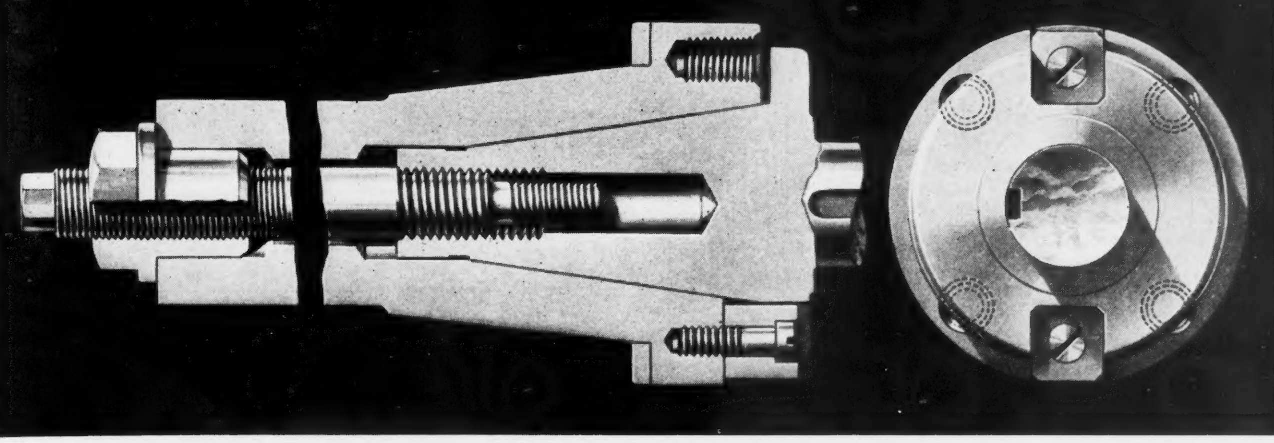
Frequently, tolerances on drawings are contradictory. When two or more sets of limits are given for dimensions in the same straight line, for example, it may be impossible to conform to both or all of them. It may be laid down as a definite rule for dimensioning that only *one* dimension in the same straight line can be controlled with fixed tolerances, and *that* dimension is the distance between the cutting surface of the tool and the locating or registering surface of the part being machined. Therefore, it is incorrect to locate any point or surface with tolerances from more than one point in the same straight line.

Another principle frequently violated in dimensioning drawings is that dimensions with tolerances should be given only between those points or surfaces where a definite relation is essential. Many dimensions are relatively unimportant, and in such cases tolerances need not be given. If given, they should be so large that it is at once evident that no great accuracy is required.

Engineers who have given much thought to the subject of dimensioning drawings with tolerances, also recommend that the initial dimensions placed on drawings should be the exact dimensions that would be used if it were possible to work without tolerances. After that has been done, tolerances should be given in the direction in which variations will cause the least harm or danger. When a variation in either direction is equally objectionable, the tolerances should be of equal amount in both directions, or "bilateral."

Attention to a few simple rules like these would prevent much of the confusion now caused by unsatisfactory, and frequently incorrect, methods of giving tolerances on drawings.

The New Standard Milling Machine Spindle



The Milling Machine Manufacturers of the National Machine Tool Builders' Association Adopt Standardized Spindle End for Milling Machines

THE greatest step ever taken in the standardization of the design and construction of machine tools and machine tool elements is recorded in this article. The milling machine manufacturers of the National Machine Tool Builders' Association, acting in cooperation, have adopted a new standard spindle end for milling machines. This action was taken with the aim of simplifying milling equipment and making it more economical for the user. The new standard has been developed after careful research and practical tests and has been adopted by the following companies:

Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Machine Co., Cincinnati, Ohio
Hendey Machine Co., Torrington, Conn.
Kearney & Trecker Corporation, Milwaukee, Wis.
Kempsmith Mfg. Co., Milwaukee, Wis.
R. K. LeBlond Machine Tool Co., Cincinnati, Ohio
Oesterlein Machine Co., Cincinnati, Ohio
Reed-Prentice Corporation, Worcester, Mass.
Sundstrand Machine Tool Co., Rockford, Ill.

The Advantages Obtained by Users of Milling Machines

Eight distinct advantages to the users of milling machines are pointed out by the manufacturers who have adopted the new standard spindle nose.

1. There is complete interchangeability of all arbors and face milling cutters, for any size and make of milling machine from 2 to 25 horsepower capacity.

2. There is a substantial reduction in the cost of auxiliary equipment, because of the elimination of a great number of sizes and varieties of milling machine arbors and cutters now in use. Approximately 250 arbors of different types and sizes now made by the nine milling machine companies mentioned will be replaced by fifteen standard arbors which will fit the new type spindle of any milling machine.

3. In developing the new standard, a new steep angle taper—3 1/2 inches per foot—has been adopted to insure instant release of the arbor, so that under no circumstances will it stick in the spindle.

4. The inner end of the arbor hole in the spindle is bored straight for an arbor pilot, thereby keeping the arbor in place while inserting or removing the draw-in arbor bolt.

5. The steep taper with its large-diameter bore at the outer end of the spindle allows the use of stronger arbors.

6. The large diameter of the draw-in arbor bolt permits it to be tightened by heavy pressure, so that the arbor will be firmly held in the taper hole of the spindle.

7. The front end of the arbor draw-in bolt is provided with an extension threaded end which will hold auxiliary equipment, and which can also be used by the provision of suitable adapters, for arbors and cutters with taper shanks used on milling machine spindles made in the past.

8. In addition to the standardized milling machine spindle nose, a complete set of new arbors has been adopted, which have been standardized in regard to diameter, length, keyway and method of designation. The complete details relating to these arbors are given in the Data Sheet accompanying this number of MACHINERY.

Development of Milling Machine Standardization Work

Twenty-four years ago, William Lodge, then president of the National Machine Tool Builders' Association, in his address at the association's annual meeting, strongly advocated the adoption of a standard for spindle ends. Since that time much

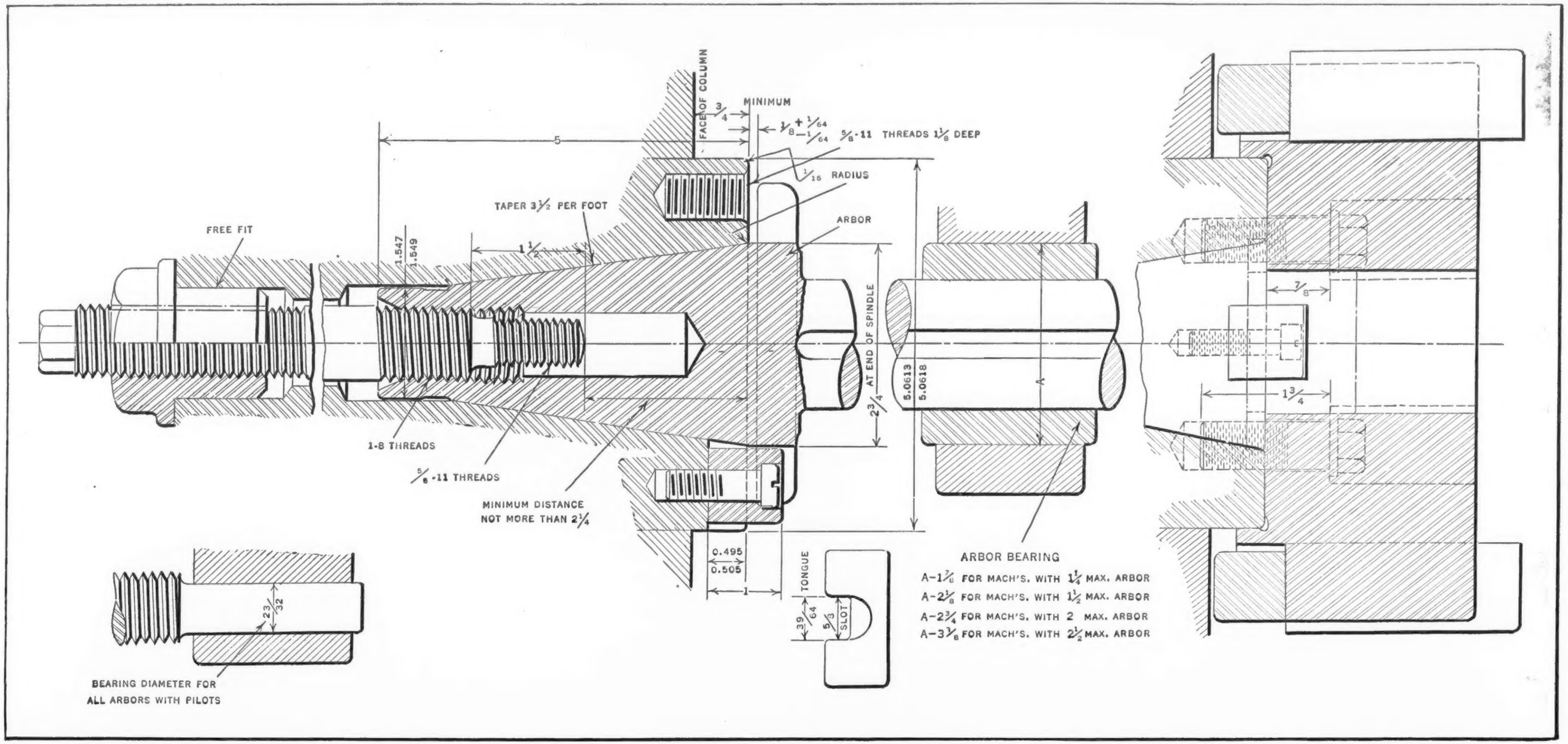


Fig. 1. The New Standard Milling Machine Spindle End Adopted by the Milling Machine Manufacturers of the National Machine Tool Builders' Association

publicity has been given to the subject. Articles and editorials have appeared in the technical press calling attention to the great economical gains that such standardization would afford milling machine users, but there have been many obstacles to its accomplishment. Hence, for many years all attempts to standardize milling machine spindle ends failed, and the manufacturers continued to make a large assortment of sizes and varieties of spindle-end designs.

Meanwhile, the development of the milling machine spindle and its tool-holding elements was closely allied to the development of the milling cutter. When cutters were small and required little power to drive them, the taper shank answered all the requirements. As arbor draw-in bolts were not used, the taper necessarily had to be small, so that the arbors or cutters would not come out while in use. Later milling machine spindle ends were threaded—at first for carrying chucks.

With the advent of high-speed steel and machines of greater power, it was found increasingly difficult to remove face milling cutters from threaded spindle ends, and when the spindle end was threaded, it was also impractical to run the spindle in either direction. These problems were met and solved by each manufacturer according to his own ideas, with the result that each manufacturer had an individual design, in sometimes two, three, or more sizes.

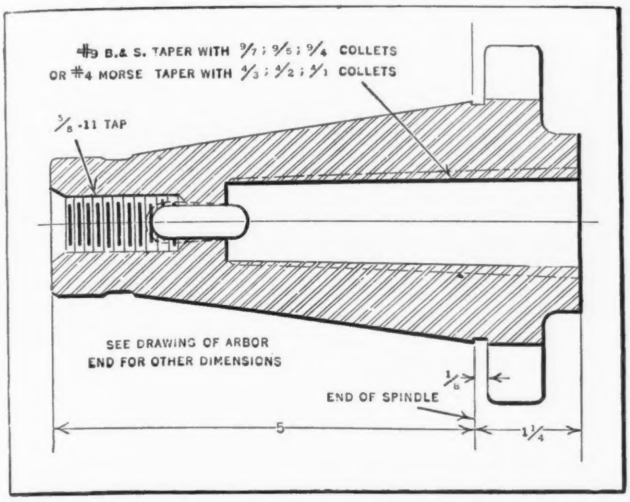


Fig. 2. Adapter for New Standard Milling Machine Spindle End which Can be Used for End-mills and Collets with Tang Drive

It has long been recognized that in the large modern shop the cost of milling machine equipment constitutes a heavy investment. This investment is greatly increased by the variety of styles and sizes of spindle ends, each requiring complete sets of arbors and different cutters. Consequently, there has been a growing demand among the users for a standardized spindle end. This demand has become more and more insistent, culminating in the announcement that the Production Division of the Society of Automotive Engineers had appointed a standards committee which would concern itself with efforts to standardize tool-holding and work-holding elements of machine tools.

The milling machine group of the National Machine Tool Builders' Association met this situation in an unusual and extremely practical manner. Instead of attempting to decide on the best of the many designs in use and adopting it as a standard —a procedure that probably would have met with little success, owing to the controversial nature of the problem and competitive considerations—a committee of engineers was appointed to pool their experience and ideas and produce cooperatively the best possible design for a milling machine spindle end that present knowledge and experience could evolve, and to adopt this as a standard.

A survey of the industry revealed that the sticking taper was one of the undesirable features common to all the present types of spindle ends. Practically all manufacturers had eliminated the sticking of face milling cutters and chucks on the spindle, but nothing had been done to prevent arbors from "freezing" in the taper hole. Some shops reported that it was their practice never to allow an arbor to remain in a spindle more than two days, and if a set-up was in use for a longer period, the arbor was taken out of the spindle and reassembled every two days. All the milling machine manufacturers and a great many users can cite instances of arbors having become so jammed in the spindle that it has been necessary to destroy either the arbor or the spindle, and sometimes both, in an attempt to release the arbor.

Hence, the new spindle end and arbor, as designed by the committee and adopted as a standard, has a taper of 3 1/2 inches per foot—a taper that experience has shown will not "freeze" or stick. This taper, as shown in Fig. 1, which gives complete details of a milling machine spindle with the new standard spindle end, serves only the purpose of accurately centering the arbor, and provides an area of contact between the arbor and spindle. The drive, however, is by tongues on the face of the spindle; a draw-in bolt of large diameter holds the arbor firmly in place. The draw-in bolt is new in design, and can be tightened without subjecting it to torsional strains.

Several machines equipped with this new style of spindle and arbor have been thoroughly tested in different shops. These tests and the research work in connection with them have extended over a period of more than two years, and have included extreme tests with steep-angle spiral mills, used in a manner tending to free the arbor in the spindle hole. As much as 35 horsepower has been transmitted and the results of all tests have proved to the satisfaction of the milling machine manufacturers that the new spindle meets all requirements.

New Standard Arbors Adopted

Encouraged by the spirit of cooperation with which the industries have received the various standards and simplified practices recently recommended by the Simplified Practice Division of the Department of Commerce, and with the aim of affording milling machine users still greater

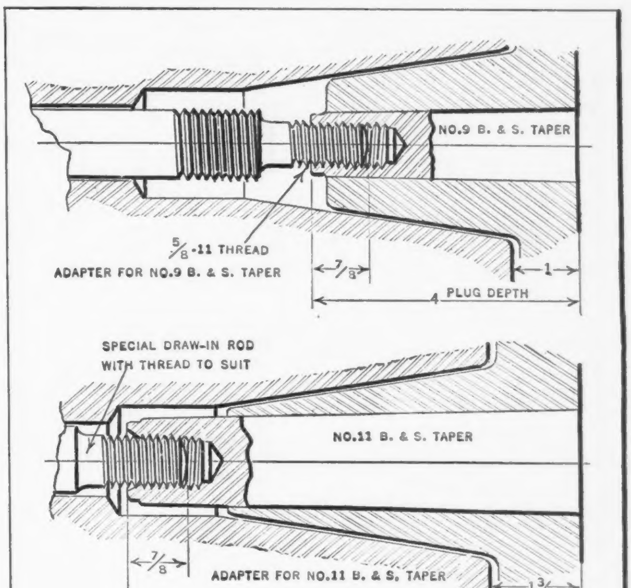


Fig. 3. Arrangement of Different Adapters to Take Arbors in Use at the Present Time

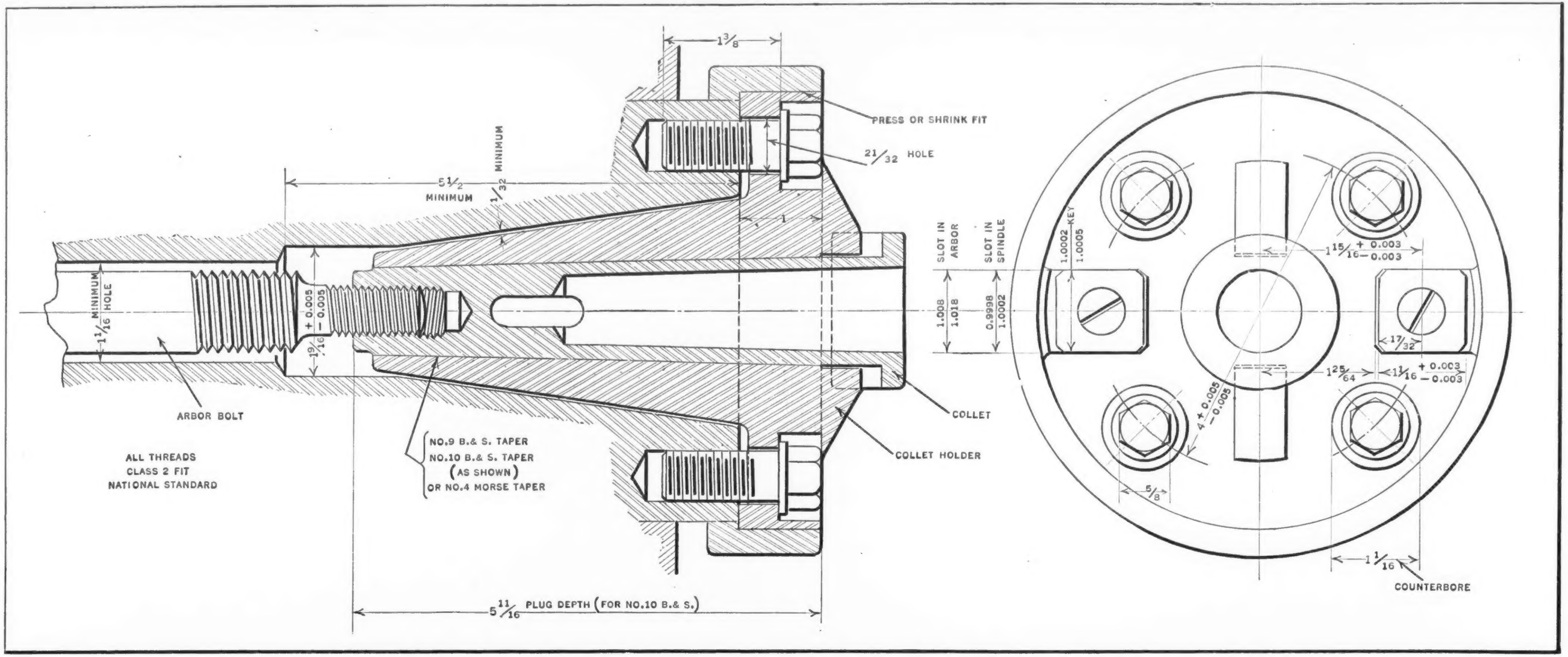


Fig. 4. Adapter for Milling Machine Spindle which Fits over the Outside of the Spindle End and is Bolted to the Spindle Face

economies, a complete set of new arbors has been adopted, standardized as to length, diameter, keyway, and bearing size. In this way, the arbor equipment of a shop will be interchangeable between all milling machines of any size or make, from 2 to 25 horsepower, that are provided with the new standard spindle. Tools bought for a No. 1 machine can be used on a No. 5 machine, irrespective of the make of the machine. To facilitate ordering, a new system of numbering or nomenclature has been adopted.

The three styles of arbors standardized, which are listed in detail on the accompanying Data Sheet, are known, respectively, as style A, teated arbors; style B, plain arbors; and style C, shell end-mill arbors. All style A and style B arbors have the new standard keyways tentatively adopted by the cutter manufacturers, and now in process of standardization by the milling cutter committee under the American Engineering Standards Committee procedure.

Arbor Nomenclature

A standardized nomenclature or numbering system has been adopted, as it was felt that this was needed for the new arbors. As mentioned, the style A, style B, and style C stand for teated type, bearing or plain type, and shell end-mill type.

The bearing sizes are designated as follows:

1 7/8 inches in diameter, No. 3 (for arbors up to and including 1 1/4 inches in diameter);

2 1/8 inches in diameter, No. 4 (for arbors up to and including 1 1/2 inches in diameter);

2 3/4 inches in diameter, No. 5 (for arbors up to and including 2 inches in diameter);

3 3/8 inches in diameter, No. 6 (for arbors up to and including 2 1/2 inches in diameter).

An arbor symbol is used which is made up of the arbor diameter, the style, the arbor length from shoulder to nut, and the bearing number; thus 1 1/4 A 18-4 signifies a style A or teated arbor,

1 1/4 inches in diameter, 18 inches long, with a bearing 2 1/8 inches in diameter.

For metric arbors, the symbol is preceded by the letter M and the diameter is given in millimeters; thus M 25 B 30-4 signifies a metric arbor, 25 millimeters in diameter, style B or plain type, 30 inches long, with bearings 2 1/8 inches in diameter.

Shell end-mill or style C arbors are made to accommodate the proposed new standard shell end-mills. These arbors have two variables, the diameter and the distance from the face of the spindle to the back of the cutter. These two variables enter into the symbol as follows: 1 1/2 C 7/8, which signifies a shell end-mill arbor 1 1/2 inches in diameter, with a projection of 7/8 inch from the end of the spindle to the back of the end-mill.

While it is expected that standard shell end-mill arbors of any one diameter will be kept in stock with only one distance from the end of the spindle to the back of the cutter, as indicated on the Data Sheet referred to, the symbol allows special arbors to be ordered without confusion.

Although the committee feels that the arbors referred to will cover the requirements of most manufacturers and users, it may be desirable for some maufacturers to carry other lengths in stock, such as short stub arbors for vertical machines. The numbering system, therefore, has been made flexible enough to allow for its use on sizes other than standard. Hence, 1 1/2 B 3 1/2 signifies a plain arbor 1 1/2 inches in diameter, 3 1/2 inches long from shoulder to nut, with no bearings.

Collet and Arbor Adapters

With the view of making it possible to use present auxiliary equipment with the new spindle ends, adapters have been designed, one fitting into the taper hole of the spindle and being held by the draw-in bolt, as shown in Fig. 2, which can be used for end-mills and collets with tang drive. Another type of adapter fits over the outside of the spindle end and is bolted to the spindle face, as shown in detail in Fig. 4; different types of this adapter are shown in diagrammatic form in Fig. 3. These adapters can be used for arbors, end-mills, and other tools that have a threaded hole for the draw-in bolt.

Among the interesting points relative to the new standard spindle, it may be mentioned that all the master gages for the tapers were made by one gage manufacturer for all the milling machine builders, with a view to insuring absolute interchangeability in the taper holes and in the equipment that fits it. The rear end of the spindle is not standardized, as it is not essential to interchangeability, but the back nut is uniform, so that one wrench is sufficient for the arbor and back nut for all milling machines of all makes and sizes.

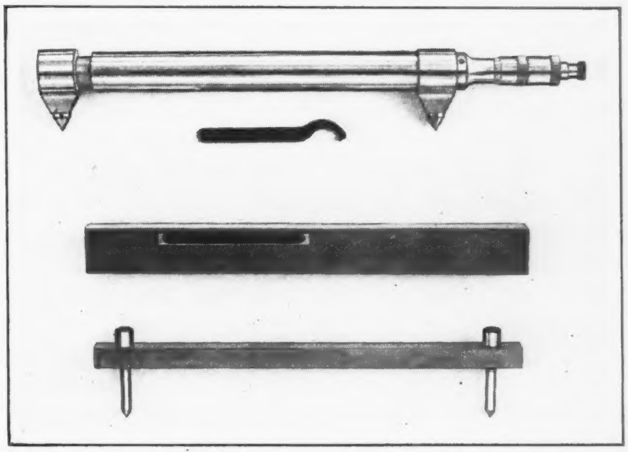
A notable fact in connection with this achievement in standardization is that it relates not to a mere engineering or structural detail, but to a purely competitive feature, as in the past, the different types of spindle ends have made it possible to make claims of superiority of one machine over another, and they have embodied features in many instances patented. The milling machine manufacturers have set an example not only for other branches of the machine tool industry, but for all other machine-building industries, showing what can be done in the way of standardization in cases where the obstacles appear to be almost insurmountable, provided there is an earnest cooperative spirit and a determination to produce the best of which the industry is capable.

* * *

CHECKING GIRDER DEFLECTIONS

Deflections existing in steel girders, bridge spans, etc., can be determined by means of the Howard strain gage just brought out by the Brown & Sharpe Mfg. Co., Providence, R. I. This tool is, in reality, a bar micrometer that is adjustable for measurements of any length from 10 to 20 inches. It has a capacity for reading deflection up to 0.004 inch, 0.002 inch either side of zero, in increments of 0.0001 inch.

In using the micrometer, two points are first located on the span to be measured while it is in the normal position. To aid in establishing these points, there is furnished a straight steel bar having hardened steel prick-punches in each end. This bar is held in the desired location and the punches are tapped with a hammer. The distance between the two points is then measured while the span is in its normal position, and later, while the span is carrying a load, another measurement is taken between the same two points. From any difference between the two readings, the desired information can be computed.



Equipment Employed in Checking Deflection of Girders

Deflection in the girder or span will either bring the two points closer together or spread them further apart. A steel test bar is furnished for checking the micrometer. Deflection in concrete spans can also be checked with the device if small metal plates are inserted in the structure.

* * *

The fourth annual convention of the National Association of Foremen will be held at Cincinnati, Ohio, May 21, on the grounds of the Cincinnati Zoo. There will be talks on the subjects "The Foreman as a Business Manager of His Department," and "Big Business Demands Big Men." Further information may be obtained from E. H. Tingley, Secretary, 1249 U. B. Bldg., Dayton, Ohio.

The British Metal-working Industries

From Machinery's Special Correspondent

London, March 18

IT is perhaps easy to be optimistic about the future of the metal-working industries in Great Britain, for things could hardly have been worse than they were during 1926. A return to prosperity may be slow in coming, but it is definitely on the way. Many branches of the great industries are still exercising a certain amount of caution—probably undue caution—but that is merely a national characteristic.

It was suggested at the beginning of this year that it would be a few months before trade made any definite step forward, as it must inevitably suffer to some extent from the disastrous events of last year. In addition, the end of the nation's financial year is near at hand, and many are waiting to learn the taxation proposals before committing themselves to large schemes. In the meanwhile, trade is making steady progress, and reports from all parts of the country are at last cheering.

A more hopeful tone is noticeable in the iron and steel industry, although purchasers are buying quietly. The high price and scarcity of coke is undoubtedly the cause of slow progress. Manufactured iron and steel producers are, however, fully employed, and quotations are steady. North of England and Scottish steel makers are better occupied, probably on account of shipbuilding activity. Constructional engineers still report increased business, and this should augur well for future trade. Unemployment is steadily decreasing, considerable numbers of men having been reengaged in the shipbuilding, construction, and railway engineering industries.

The Machine Tool Industry is Steady

Machine tool makers still go along steadily, and generally seem satisfied with the business obtainable. No startling orders have been placed during the month, but there is sufficient demand to keep everybody working full time—a much better state of affairs than existed two or three years ago. Foreign railways and colonial enterprises continue to provide a goodly share of machine tool business, while the Crown Agents for the Colonies are still very good customers. As trade revives at home, machine tool makers will undoubtedly feel a great benefit, for many firms have refrained from installing new equipment for some time.

The British Industries Fair which has just closed should do much to restore prosperity to the machine tool industry, as it is officially reported that orders to the extent of over £4,000,000 have been placed in the heavy engineering and hardware section at Birmingham. This figure may easily be trebled or quadrupled when the probable future effects of the fair have been felt. Over 90 per cent of exhibitors have booked space for next year, and the exhibition will again be considerably enlarged. All this will undoubtedly benefit the machine tool industry of the country. New Zealand Railways are again in the market for quantities of machine tools and equipment.

Exports of Machine Tools Rise, While Imports Fall

The exported tonnage rose considerably during January—from 956 to 1306 tons—with a corresponding rise in total value from £108,557 to £148,106. The ton value decreased £1, dropping to £113. The value of tools and cutters also rose £3500, reaching a total of £51,925. The exports, altogether, are fairly gratifying, having reached the figures at the beginning of the coal stoppage last year. The tonnage is better than in any average month for any year since 1921, and a little better than the pre-war average.

The machine tool imports dropped again in tonnage from 574 to 525 tons, but rose slightly in value to £105,338, representing a ton value of £201—a sharp rise of £42. The January figures, as a whole, however, indicate a change for the better in the machine tool trade.

From the classified exports for January, lathes were the best sellers with £51,372, a rise of £12,000 over the previous month. Drilling machines came next with £26,577, which was practically double the figures for December. Grinding machines, and planers and shapers accounted for £13,205 and £12,179—slightly better figures than the previous ones. Milling machines suffered a drop of £4000, and punches, presses, and shearing machines a decrease of £5000. Spain, Brazil, and France accounted chiefly for the increase in lathe exports.

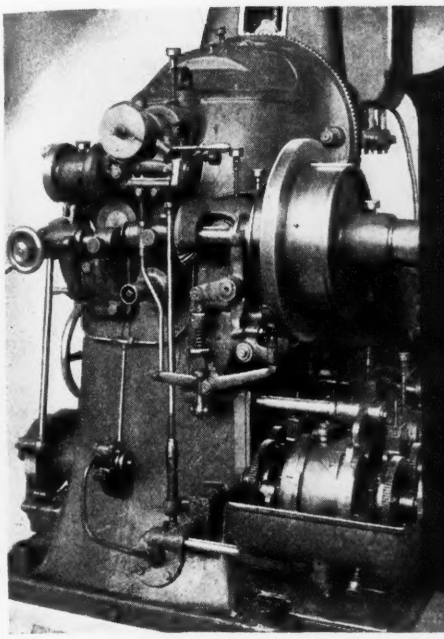
Shipbuilding Industry Improves

That shipbuilding prospects have improved and are still improving is evident, because the amount of work on hand at the yards is increasing steadily; several yards have also been reopened. Since the beginning of the year, the new contracts announced make a total far higher than that completed or launched, and the diversity of types of vessels indicate that conditions are rapidly improving. Shipbuilding repair work is also being regained from the Continent.

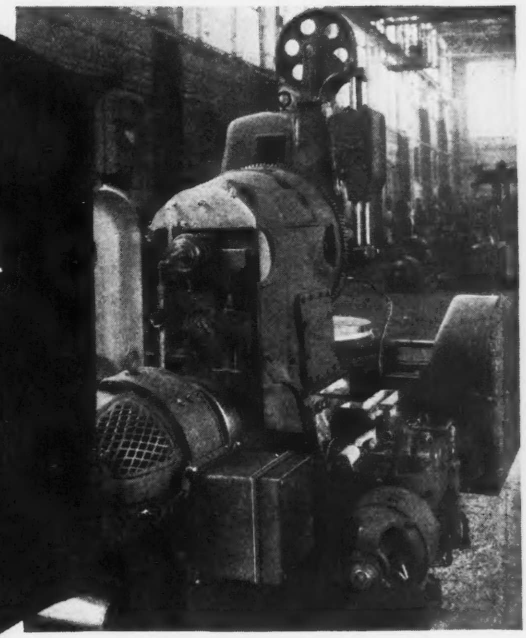
General Engineering Conditions are Good

Railway companies are beginning to disclose their building plans for 1927, the London, Midland & Scottish Railway, for example, having announced that 473 engines, costing from £5000 to £8000 each, will be required.

The electrical engineering branch of industry is still prospering, overseas business being particularly good. The textile machinery trade is quiet at the moment, but new orders are hoped for from Russia. Constructional engineering is almost on a par with the heavy electrical section in many districts, and very good business is reported.



Designs Simplified by Electrical Means



Some Examples of the Simplification of Machinery by the Use of Motor Drives and Electrical Controlling Apparatus—Second of Two Articles

By H. L. BLOOD, Chief of Machine Design Division, Western Electric Co., Inc.

IT will be evident to the readers of this article (the first installment of which appeared in March MACHINERY) that important improvements may be made in the design of various classes of machines by the proper application of electrical drives and controls. The writer has included a number of examples of electrical applications that are somewhat exceptional, and in certain instances it has been possible to accomplish unusual results by the electrical means described. This installment, which concludes the article, deals with the application of motor drives and electrical controls to radial drilling machines, lathes, power presses, and planers.

Direct Motor Drive for Radial Drilling Machine

The radial drilling machine shown in Fig. 5 is a good illustration of the extent to which a machine may be simplified when it is designed for individual motor drive. An adjustable-speed direct-current motor is mounted on the arm and drives a horizontal shaft, either directly or through back-gears. The horizontal shaft is geared directly to the spindle. Except for an occasional shifting of the back-gears, the spindle is controlled entirely by means of a drum controller mounted on the head. The wires running to the controller are carried in a flexible conduit at the back of the arm. The motor and the spindle can be reversed almost instantly by turning the controller handle at the bottom of the head, and it is therefore unnecessary to provide friction clutches or reversing gears for tapping. The omission of these parts results in a decided simplification of the machine, without adding to the electrical equipment.

Although the majority of machine shops are supplied with direct current, it is necessary for machine tool builders to provide alternating-current drives for the benefit of those shops (usually the smaller ones) in which direct current is not available. A radial drilling machine arranged for alternating current drive, but otherwise similar to the one just described, is illustrated in Fig. 6. The alternating-current machine includes a gear-box giving eighteen changes of speed, this gear-box taking the place of a similar unit on the direct-current machine, which contains only the back-gears. All other parts of the alternating-current and direct-current machines are alike, which, of course, is highly desirable from the manufacturing standpoint.

In order to make the alternating-current and direct-current machines so nearly alike, it was necessary to provide a simple control by which the alternating-current motor could be started and reversed easily and quickly. The conventional type of drum controller for slip ring motors, which starts the motor by connecting the primary to the line and inserting resistance across the secondary as the motor gains speed, would have been somewhat too large to mount on the head of the radial drill and would have been too heavy to turn quickly; it would also have been necessary to run a large number of wires for the primary and secondary circuits to the movable head.

Method of Starting and Reversing Alternating-current Motors

The method of control that was developed for the machine shown in Fig. 6 has none of the disadvantages mentioned, requires a minimum number of moving and wearing parts, and starts and reverses the motor in the shortest time consistent with safety, regardless of how rapidly the controller handle is turned. Mounted on the head of the machine is a simple drum controller which connects the primary to the line in either direction. This controller is compact, and having only a small number of contact fingers is easily turned. Across each phase of the motor secondary is connected a

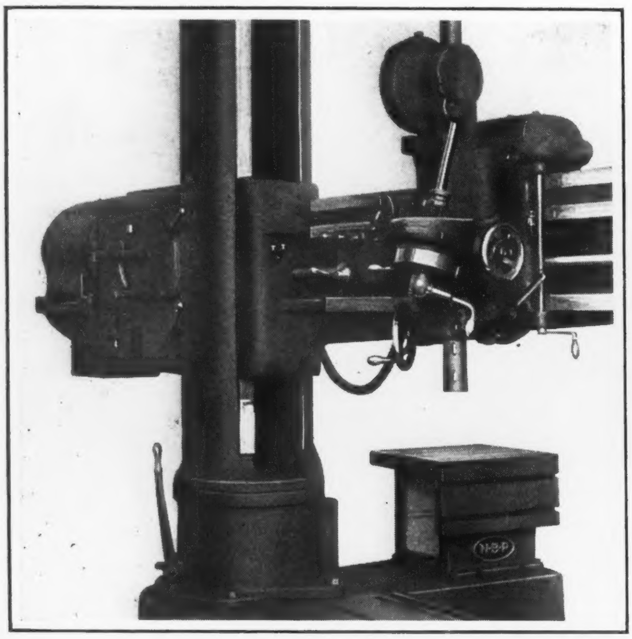


Fig. 5. Radial Drilling Machine Driven by Direct-current Motor Mounted at End of Arm

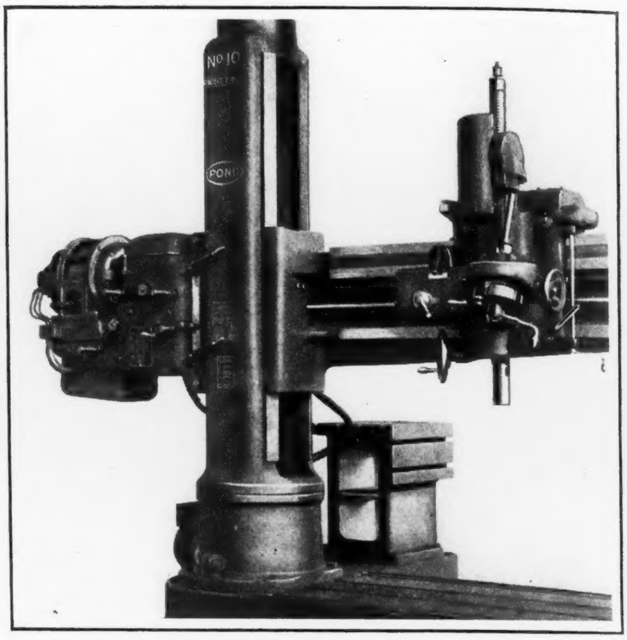


Fig. 6. Radial Drilling Machine Arranged for Alternating-current Drive

group of grids in multiple with a coil of heavy wire. The grids and coils are enclosed in a box which may be seen below the motor.

The operation is as follows: Suppose that the primary is connected to the line while the motor is at rest. The motor acts as a transformer and a current is induced in the secondary which has the same frequency as the line current. At this frequency only a small current can flow through the coils connected across the secondary, and consequently most of the secondary current must flow through the resistance grids. Starting conditions are, therefore, much the same as with the conventional type of drum controller which connects resistance across the secondary.

As the speed of the rotor increases, it approaches the speed of the rotating magnetic field of the primary. The winding of the rotor, therefore, cuts the magnetic field more slowly, lowering the frequency of the induced current, and consequently a heavier current can flow through the coils in the secondary circuit. When the normal running speed has been reached, the frequency in the secondary is so low that the coils of heavy wire act practically as a short circuit across the secondary, this being, of course, the ideal running condition.

When the machine is used for tapping, the primary switch may be reversed instantly while the motor is running, causing the motor to reverse quickly but without an excessive current inrush. The action of the coils is the same when reversing as when starting the motor, except that the secondary frequency is twice as great, because the rotor and magnetic field revolve in opposite directions, and the higher frequency makes the coils more effective in limiting the current. The motor may be stopped very quickly by reversing the controller handle for an instant and then turning it to the "off" position before the motor has had time to start in the new direction; consequently no brake

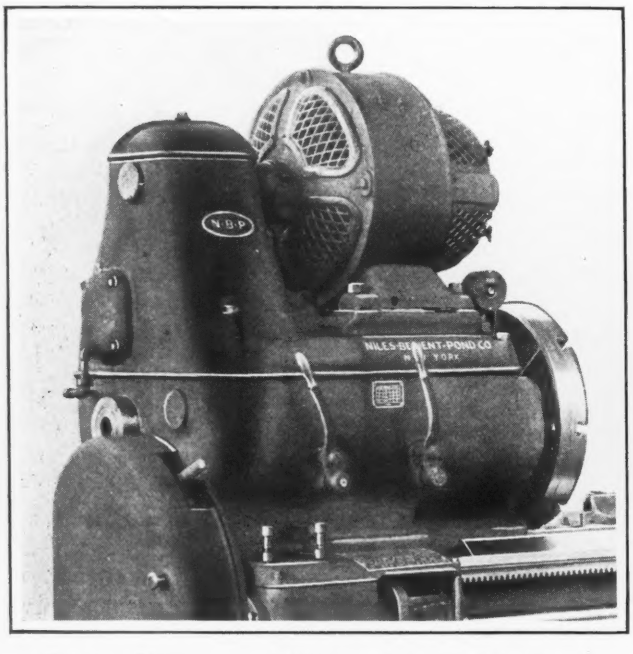


Fig. 7. Direct-current Motor Drive Applied to Lathe

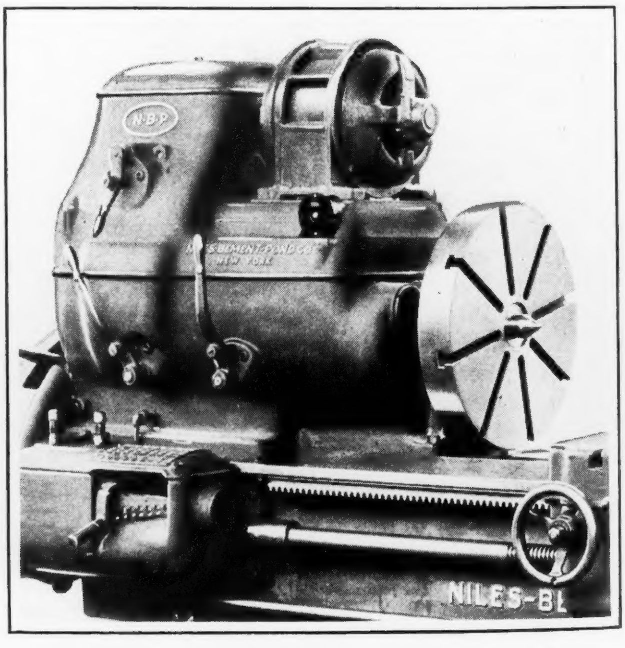


Fig. 8. Lathe Driven by Alternating-current Motor

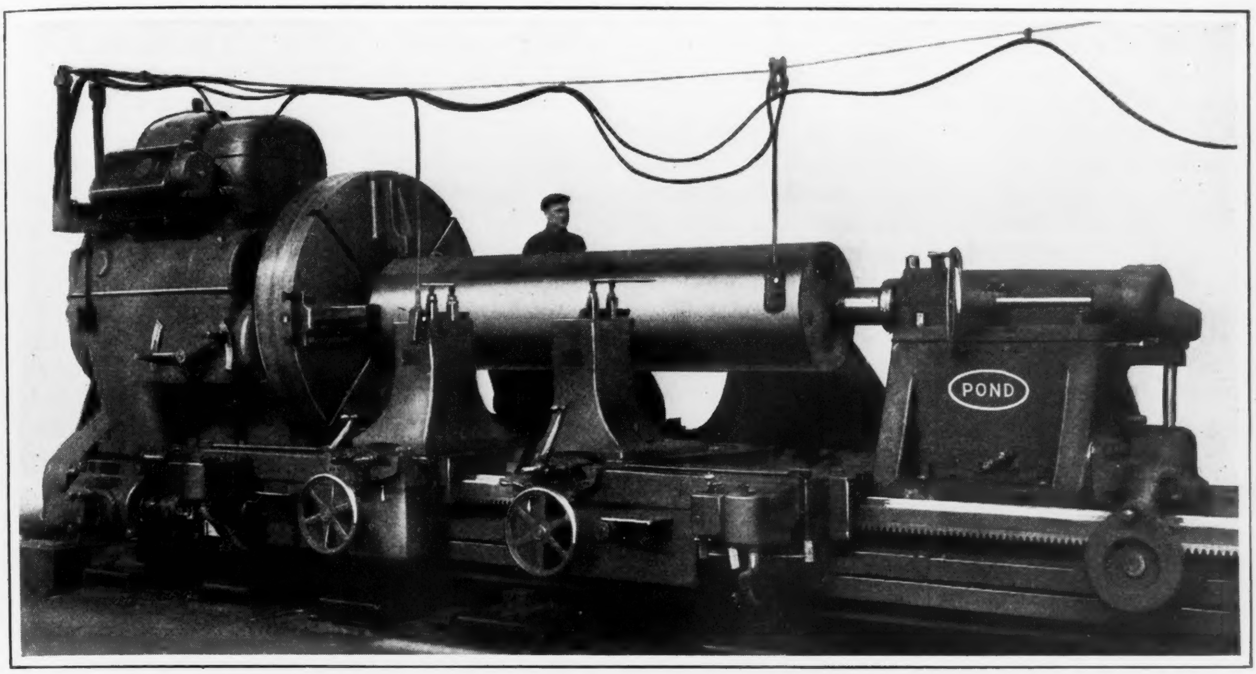


Fig. 9. Large Lathe which may be Controlled from Push-button Stations Located at Different Points

is necessary. This method of starting and reversing alternating-current motors might be used to advantage in connection with many other types of machinery. A very gradual start may be obtained, if desired, by correctly proportioning the coils and resistance.

Motors that are Stalled during Normal Service

Another interesting application of electric motors is illustrated in connection with the radial drilling machine shown in Fig. 6. The column of this machine is clamped by a screw, which is turned by a small motor through worm-gearing. The motor is controlled by a small drum switch mounted on the head within easy reach of the operator. To clamp the column, the handle of the controller is pushed toward the right for approximately two seconds and then released, being returned to the "off" position by a centering spring. The motor turns the screw until it is stalled by the tightening of the clamp. To release the clamp, the controller handle is pushed to the left for a few seconds, causing the motor to turn the screw in the opposite direction. The motion of the screw is limited by a spring, so the motor can run only long enough to release the clamp and is then stalled; consequently the motor never has to make more than a few revolutions to tighten the clamp.

When the machine is arranged for direct current, a series motor is used for operating the clamp. The resistance of this type of motor in the smaller sizes is sufficiently high so that the motors can be guaranteed to withstand stalling for several minutes without injurious heating. For operation on alternating current, a special motor of the commutator type is furnished, and a fixed resistance is

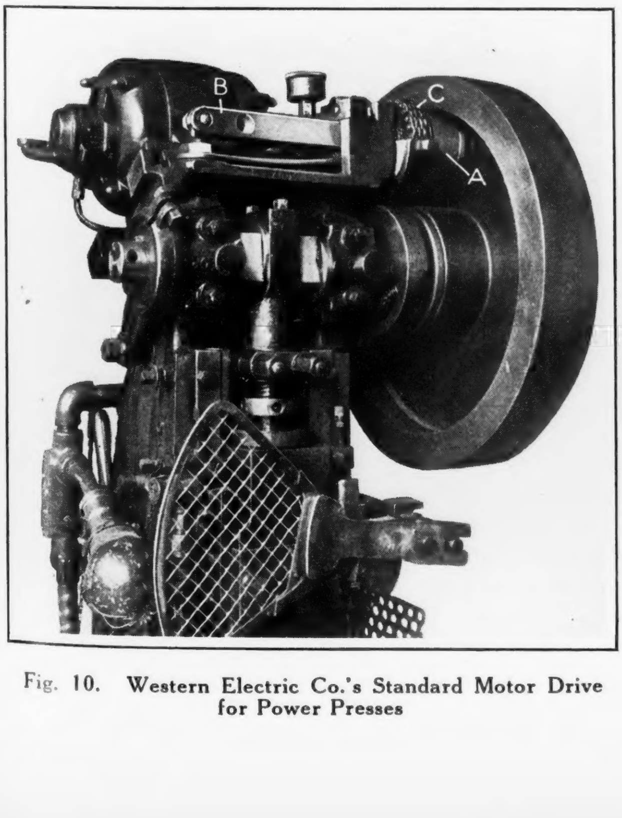


Fig. 10. Western Electric Co.'s Standard Motor Drive for Power Presses

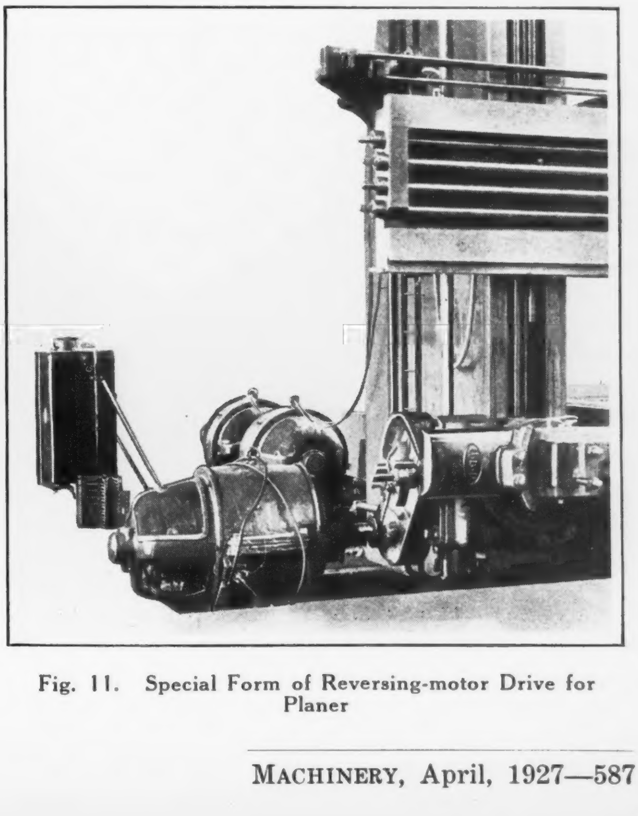


Fig. 11. Special Form of Reversing-motor Drive for Planer

used between motor and line to limit the current. Otherwise the alternating-current motor is controlled in the same way as the direct-current motor.

Motors capable of being stalled have been used in various other ways. For example, they are applied to large gate valves which may be controlled from a distance. Such motor applications are still comparatively rare, but it seems probable that motors of this type will be more generally used as engineers and designers become more familiar with them.

Motor-driven Lathes and Controlling Devices

A lathe equipped with a direct-current motor is illustrated in Fig. 7. A noteworthy feature is the absence of a clutch and the resulting simplicity of the machine, the motor being geared directly to the spindle. The motor is controlled by means of a handle on the carriage, which operates a small master switch connected to a magnetic controller. The master switch, being small, is much more easily operated than a plain drum controller. In addition, the use of a magnetic controller makes it impossible for the operator to overload the motor or the machine by a too rapid manipulation of the control handle.

The controller is of the dynamic braking type, and when the proper amount of braking resistance is used, will stop the machine smoothly and without shock when the control handle is turned to the "off" position. Standard controllers, either of the magnetic or drum type, will often be found to stop the motor more quickly than is desirable for certain applications, especially if the inertia of the driven parts is great. In such cases, it is usually a comparatively simple matter to insert additional braking resistance in the standard controller so that the machine may be stopped smoothly and without shock.

These lathes are built in 27-, 30-, and 36-inch sizes, and for lathes of these sizes it is highly desirable to have some means of turning the driving gears at a slow speed, so that they may be shifted easily. This is accomplished by means of a push-button, which may be seen below the motor. This button is connected to the automatic controller in such a way as to cause the motor to run very slowly, making it impossible for an unskilled or careless operator to clash gears. The push-button is located close to the gear-shifting levers, making it possible for the operator to press the button with one hand while moving the levers with the other. The push-button is also used to turn the chuck from one jaw to another while setting up work.

In Fig. 8 is shown a lathe similar to the one just described, but arranged for alternating-current motor drive. The motor is geared directly to the spindle without the use of a clutch, and is started and stopped from a handle on the apron, the handle being connected through a splined shaft to a push-button controlling an automatic compensator. The splined shaft also operates a mechanical brake, which is set by a spring when the control handle is in the "off" position. An additional push-button is provided to turn the motor slowly when shifting gears, as described in connection with the direct-current machine.

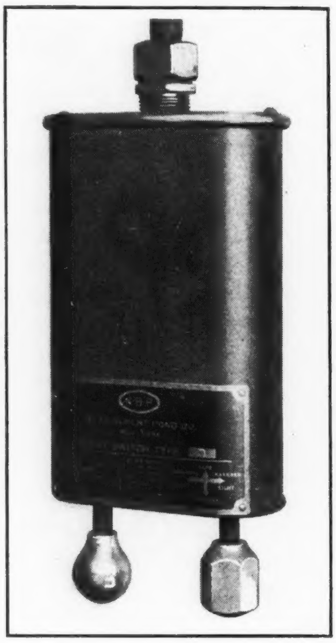


Fig. 12. Double Pendent Switch for Planer Control

Fig. 9 illustrates an interesting combination of electrical equipment applied to a large lathe. The spindle is completely controlled from any one of the push-button stations which hang above the machine and which are easily reached by the operator whether he stands on the floor or on one of the carriages, the latter position often being the one from which he can obtain the best view of the work. The spindle is driven without the use of a clutch or belt by an adjustable-speed direct-current motor controlled by a large drum controller which may be seen at the top of the lathe head. A small motor, which will be called the "pilot" motor, drives the controller drum by means of a worm and gear. The pilot motor is in circuit with the push-button stations, and when any one of the "fast" buttons is pressed, the pilot motor turns the drum, starting the main motor and increasing its speed until the operator takes his finger from the button or until the limit of the drum is reached. Before the drum can be turned too far in either direction, a contact on the drum opens and stops the pilot motor, but does not prevent it from running in the reverse direction. By pressing one of the "slow" buttons, the operator can turn the controller backward and reduce the spindle speed as much as desired.

Pressing any of the "stop" buttons opens a contactor mounted on the back of the head, disconnecting the main motor instantly and stopping it quickly by dynamic braking. The pilot motor automatically returns the controller to the "off" position, and the machine is ready to be started as before.

Standard Motor Drive for Power Presses

A somewhat unusual method of attaching a motor to a machine is shown in Fig. 10. This is the standard drive used by the Western Electric Co. for power presses. The flywheel is driven by a compressed cork friction roller *A*, which turns on one end of shaft *B*, and is pressed against the inside of the flywheel rim by a spring under the shaft. The other end of the shaft is hinged. The cork roller is driven by the motor through a chain *C*, which is covered by a guard (not shown). With this drive it is unnecessary to cut gear teeth in the flywheel, which would be objectionable from a safety standpoint. The drive is smooth, quiet, and compact, having no projecting parts which would increase the floor space or restrict the light.

Special Reversing-motor Drive for Planers

For driving planers, the direct-connected reversing motor has largely superseded mechanical

means, such as belts and the many types of clutches that have been used for this purpose. The conventional direct-current reversing motor drive is too well known to need description, but a special form is shown in Fig. 11. This drive differs from the usual reversing motor drive in that the controller is replaced by a motor-generator set, which supplies current to the planer motor. A master switch on the planer controls the field of the generator. When this field is reversed, the polarity of the generated current is changed, and the planer motor reverses quickly and smoothly. The time required for reversal may be controlled in the design of the generator and planer motor.

A rheostat in the generator field circuit makes it possible to operate the planer motor on low voltage during the cutting stroke and on high voltage during the return stroke, permitting the use of lower cutting speeds and much higher return speeds than would be available otherwise. Only a few contacts are required to control the planer, and as these transmit very small currents, they require practically no attention. Either an alternating-current or direct-current motor may be used to drive the generator.

A double pendent switch hangs above the planer table. One of the knobs of this switch (see Fig. 12) controls the planer motor and the other one controls a smaller motor which feeds and traverses the heads. By twisting the first knob, the planer table can be made to move in either direction at a slow speed which is suitable for setting up work. When the knob is pulled down, the table reciprocates automatically in the ordinary way. Pushing the knob up stops the planer.

The traversing of the heads is controlled in a similar way by the other knob. After any of the heads have been connected to the traverse motor by the movement of small clutch levers, they may be traversed rapidly in either direction by twisting the knob. Or, if the knob is pulled down and then twisted, the motor will "creep" so slowly that a head may be moved a few thousandths at a time when a tool is being set to a gage. In order to obtain this slow speed, a small generator is used to supply current to the motor. The pendent switch connects the generator field to the line in series with a high resistance, so that a low voltage is generated, and this low voltage, applied to the motor, produces the "creep."

Drives using the same basic principles as the one described are ideal where smooth, rapid acceleration and deceleration are required, and have been used extensively in connection with rolling mills, elevators, mine hoists, and steering gears.

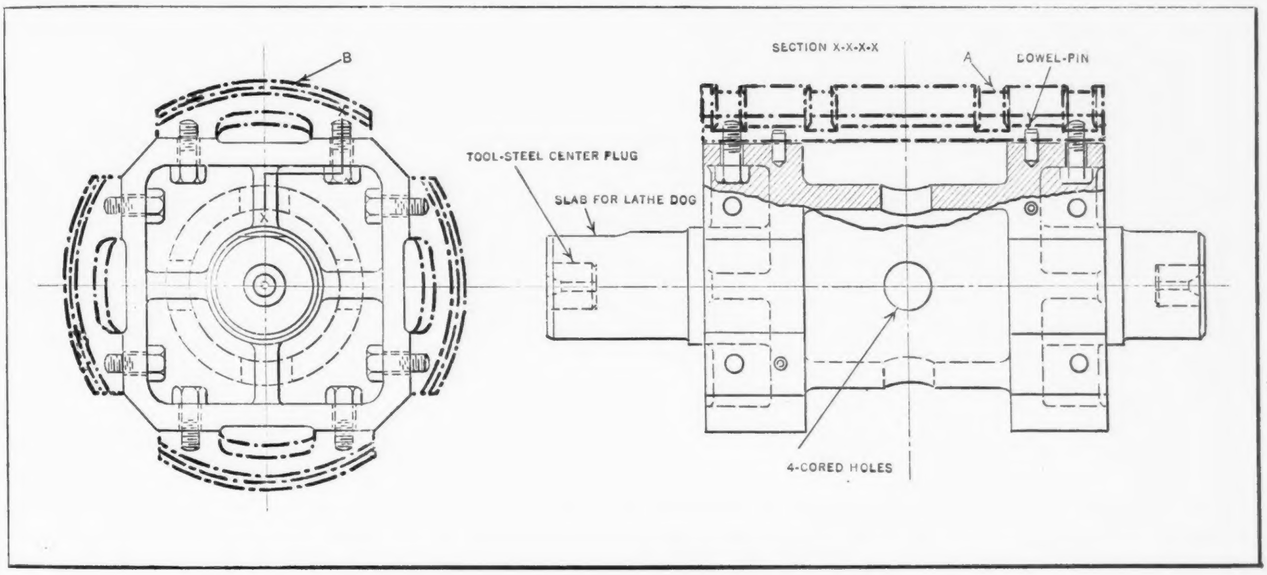
Many of the control systems described in this article have been patented in combination with certain types of machines. It would be advisable, therefore, to investigate the patent situation before using similar combinations.

* * *

MACHINING CROSS-HEAD SHOES

By C. W. PUTNAM

The mandrel shown in the accompanying illustration is used for holding the cross-head shoes shown by heavy dot-and-dash lines while turning the outer bearing surfaces and the anchorage grooves. After the shoes are rough-milled to shape, they are drilled and tapped to receive the holding bolts and dowel-pins. A drill jig is employed to locate the bolt and dowel-pin holes.



Mandrel Used in Turning Operations on Cross-head Shoes

In the second operation, the shoes are bolted to the mandrel, the four anchorage grooves, one of which is shown at *A*, turned, and the outer bearing surface *B* rough-turned ready for tinning. In the third operation, the finish-milling operations are completed. The fourth operation consists of tinning and then babbitting the surfaces that are to have a babbitt bearing surface. In the fifth operation, the shoes are again bolted to the mandrel and finished to size. The sixth and final operation consists of scraping the babbitt bearing surface to give a good fit on the cross-head.

* * *

There are in the world today 900 broadcasting radio stations, and it is estimated that there are from 12,000,000 to 15,000,000 radio sets in use, nearly half of which, or 5,500,000 are in the United States.

Fixtures Operated by Compressed Air

First of Two Articles on Pneumatically Operated Fixtures and Devices

By B. J. STERN

B. J. Stern

COMPRESSED air has been utilized in machine shops for many years, chiefly for blowing chips from the work during machining operations and for cleaning purposes. The fixtures that first used compressed air for clamping the work in place were crude affairs and were far from being efficient. However, the demand for higher production rates in recent years has stimulated the development of pneumatically operated fixtures. Those described in this article are in successful operation in a thoroughly modern plant, and indicate the progress made in perfecting fixtures of this kind.

It may be of interest here to outline briefly the method of using compressed air for the operation of fixtures. Of course, a prime necessity is an efficient air compressing plant capable of supplying air at a pressure of about 75 pounds per square inch and in quantities sufficient for continuous operation. The heart of a fixture is the cylinder which contains the piston on which the compressed air acts. A cylinder of the design commonly used is shown in Fig. 2.

B. J. STERN, after graduating from a technical high school in New York City, spent three years as a machinist, principally with the American Machine & Foundry Co., Brooklyn, and then became a draftsman with the Sperry Gyroscope Co. of the same city, specializing in the design of tools and production machinery. For six years he designed machinery and tools for various concerns in and about New York City, and then for one year was production manager for the Combined Engineers and Founders of Long Island City. For the last three years, industrial engineering and the laying out of industrial plants for production has constituted his specialty. His technical education, in addition to extensive reading of engineering books and periodicals, was obtained by attending for six years the night courses of the Brooklyn Polytechnic Institute and Columbia University.

Air is piped to the two ports *A* and *B* in the cylinder body *C*, where it exerts pressure upon the piston *D*. This piston is of the double-acting type, and consists of two leather cup packings *E* separated by the steel disk *F* and supported by the steel plates *G* and *H*. The assembled members of the piston are held together by machine screws, as indicated in the view at the left-hand side of the illustration. Spring wire rings like the one shown at *J* are sometimes fitted in grooves cut in the periphery of the plates *G* and *H* for the purpose of keeping the leather cups pressed against the cylinder walls, to prevent air leakage past the piston.

The piston is clamped against the shoulder on the piston-rod *K* by the nut *L*. A stuffing-box *M* is usually incorporated in the cylinder cover *N* to prevent air from leaking past the piston-rod. The simple cylinder construction shown in Fig. 2 is suitable for most purposes. Of course, the pressure exerted by the piston-rod in performing its work varies directly as the diameter of the piston. Disregarding friction and leakage losses, a 6-inch piston, with an air supply of 75 pounds per square inch, would exert a pressure of about 1 ton.

Valve for Controlling Air-operated Fixture

It is necessary to govern the admission of the air to the cylinder ports so that the piston will be moved back and forth in accordance with some prearranged plan. This is usually done by means of valves like the one shown in Fig. 1 or Fig. 3. The valve shown in Fig. 1 is used to control a single-acting piston; that is, it controls the admission of air to a cylinder having only one port. This valve is actuated by the operator's foot. By pressing spring plunger *A* down, the groove *B* in the plunger is brought into line with the supply inlet *C* and the outlet *D* to the cylinder.

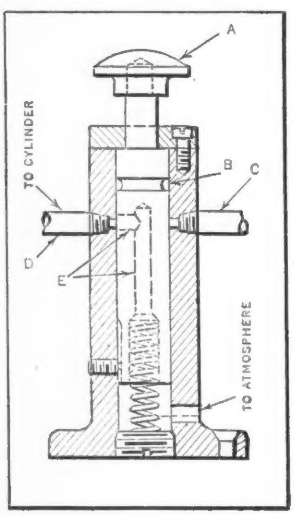


Fig. 1. Control Valve for Single-acting Piston

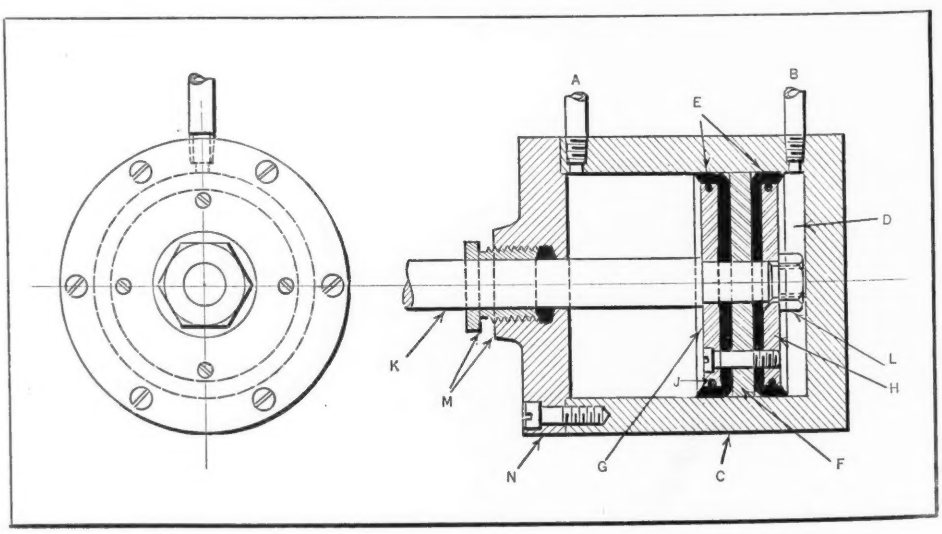


Fig. 2. Construction of Air Cylinder of the Type Commonly Used for Operating Fixtures

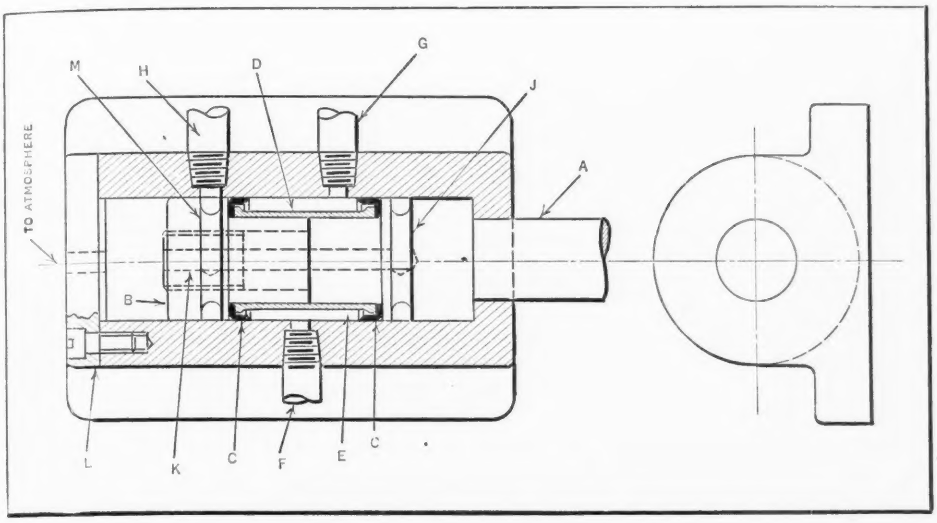


Fig. 3. Valve for Controlling Double-acting Air Piston

haust groove *M* in part *B* lines up with the outlet port *H*, so that the spent air is exhausted into the atmosphere.

When the plunger is pushed all the way in, the air pocket *E* moves away from the outlet *G* and opens into the outlet *H*, which is piped to the opposite side of the piston. At the same time, the groove *J* in the plunger *A*, comes in line with port *G*, so that the spent air, being forced back from the cylinder, travels around this groove through cross-holes in the plunger that communicate with the central hole *K* in the plunger, and thence through this hole and the one in valve cover *L* out into the atmosphere. Thus the outlet ports *G* and *H* serve both to bring compressed air to the cylinder and to permit the spent air to be exhausted.

The air from the supply inlet, traveling around the groove, passes through the port *D* into the cylinder, and there actuates the piston. The piston, in turn, exerts its power or pressure on the connecting-rod as long as the operator keeps his foot on plunger *A*. As soon as the plunger is allowed to rise and shut off the air supply, the cross-hole *E* in the plunger, coming in line with outlet port *D*, lets the spent air escape from the cylinder, after which the piston is returned to its original position. The return of the piston, in this case, is accomplished by mechanical means.

The valve shown in Fig. 3 is used for controlling the movement of a double-acting piston. The cylinder in which this type of piston is assembled has two air ports. The valve plunger stem *A* is actuated by a cam which causes the valve to admit air to either side of the piston automatically in accordance with a predetermined cycle.

The valve plunger consists of two parts *A* and *B*. Part *B* is screwed on part *A*, as indicated, compressing the cup packings *C* at the ends of the supporting cylinder *D*, thus making the pocket *E* air-tight. This pocket is always kept filled with air by the supply inlet at *F*.

When the valve plunger is at the extreme end of its stroke, as shown in the illustration, the air pocket opens into the outlet *G*, which is piped to one side of the piston. At the same time, the exhaust groove *M* in part *B* lines up with the outlet port *H* (see above).

Air-operated Fixture for Counterboring Operation

In Fig. 5 is shown a counterboring fixture for the hard rubber semi-spherical ball *W* shown in heavy dot-and-dash lines. This fixture is mounted on the table of a small sensitive drilling machine. The clamping and unclamping of the work is performed automatically and simultaneously with the lowering and raising movements of the drill spindle. When the fixture is in use, the operator places a piece of work *W* in the nest *A* on the top of the cylinder casting *B*. The counterbore *C* is then fed down by turning the handle *D* in the usual manner. This operation also serves to admit air to the port *E* in the cylinder, causing the piston *F* to move downward. The lever *G*, which is connected to the piston, is thus drawn downward, clamping the work *W* securely in place.

After the counterboring operation, the drill press spindle is raised. This movement of the spindle causes the air to be exhausted from port *E* and allows air to be admitted to port *J*, which serves to force the piston upward, releasing clamp *G* so that the work *W* can be removed and replaced.

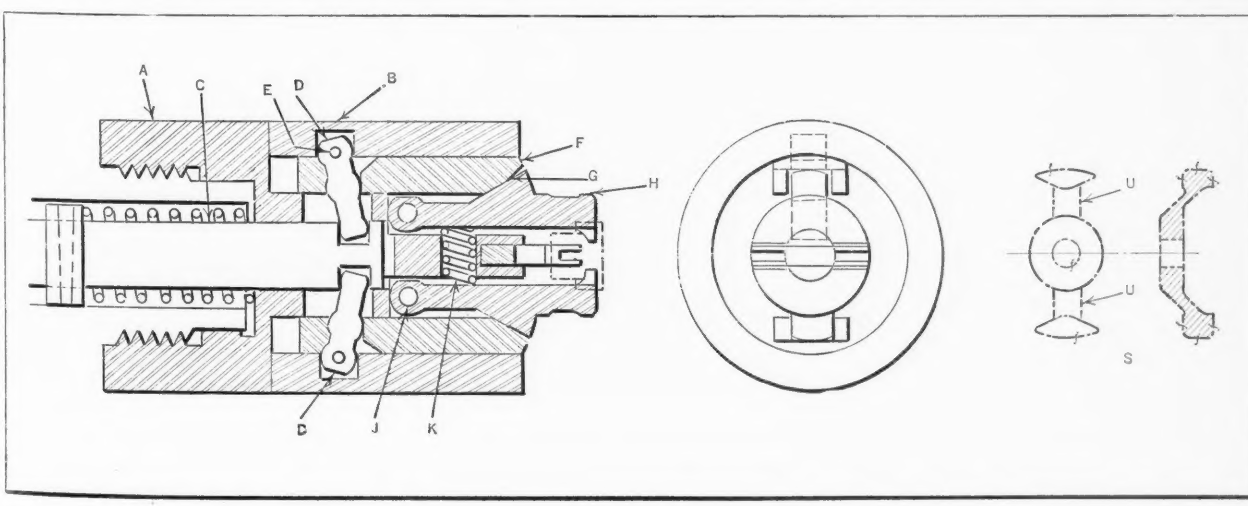


Fig. 4. Air-operated Chuck Used on Turret Lathe for Holding Piece S

The automatic clamping and unclamping movements effected by the piston F are controlled by means of the disk valve K, secured to the side of the drill press column. The handle shaft L, which is geared to the rack of the spindle of the drill press in the usual manner, is also keyed to the disk M of the valve. The valve consists of the base N, which is fastened to the drill press column, and the cover O, which is fastened to the valve base.

Between base N and cover O is a brass disk M which is keyed to the shaft L. A groove P is cut through disk M. On the side of this disk that is in contact with the base N, a groove Q is cut, which extends only half way through the disk. Air is admitted through the cover O at R, filling the entire chamber and, of course, the groove P.

When the drill handle D is turned to bring the counterbore down, the disk M is also turned so that the groove P communicates with the holes S drilled in the base N. Air is thus admitted to the pipe leading to the cylinder port E, which results in tightening the clamp G down on the work. At the same time, the spent air on the other side of the piston is forced back through port J and holes T in the base N, so that it reaches the groove Q in the disk, which carries the exhaust air out through the holes V in the base.

When the work is completed, handle D is turned back, causing disk M to roll and block the incoming air from port E, and at the same time line up the inlet groove P with hole T, so that compressed air is admitted to port J in the cylinder, thus releasing the clamp. The exhaust air then escapes through port E and holes S in the base, through the exhaust outlet Q in the disk, and out into the atmosphere through hole U. The disk M is kept in contact with the base N by the spring X.

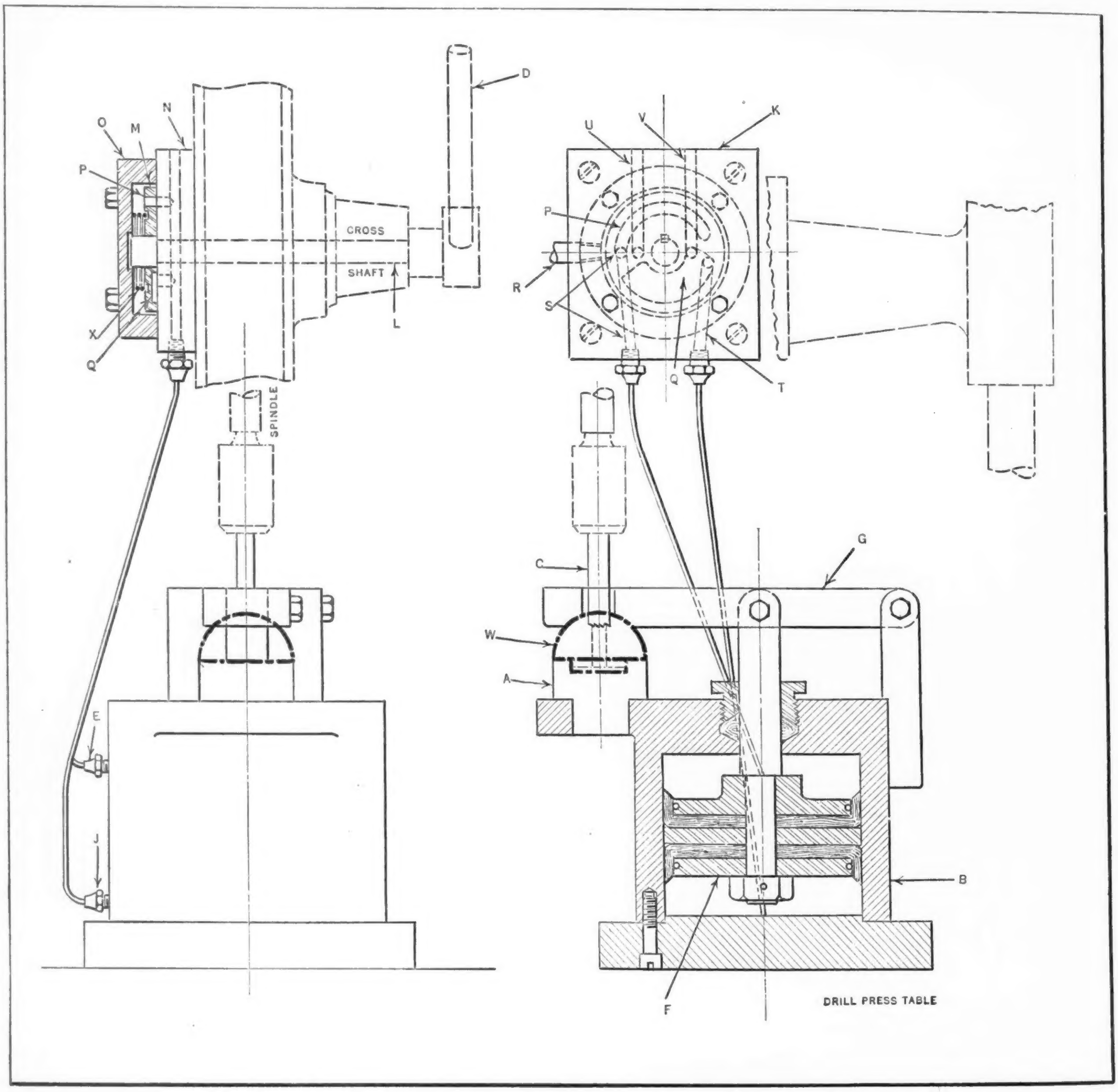


Fig. 5. Counterboring Fixture Equipped with Air-operated Clamp

Air-operated Chuck

While air-operated chucks such as are commonly used on turret lathes and screw machines are fully described in the catalogues of firms specializing in such equipment, the air-operated chuck shown in Fig. 4 possesses some features that may be of general interest. This chuck is employed on a turret lathe to hold brass castings like the one shown at S.

The chuck mechanism is contained within the sleeves A and B. The work-gripping action of the chuck is obtained by means of the draw-rod C connected to the air piston of the cylinder at the end of the machine spindle in the usual manner.

The movement of the draw-rod which actuates the chuck jaws is controlled by the operator through the hand valve that governs the flow of air to and from the cylinder. When draw-rod C moves forward, it causes the hardened levers D to pivot on pins E in sleeve B. As the lower ends of levers D are moved forward, they force the hardened sleeve F forward. The bell-mouthed end of sleeve F fits the taper G on the hardened gripping levers H, which are pivoted at J on pins that pass through the sleeve A. Levers H are forced together by the action of sleeve F, thus causing the jaws at the outer ends of levers H to grip the casting S on the ribs U. The ends or jaws of levers H are formed to fit the contour of the work.

The spring K, which is compressed when the jaws are tightened on the work, releases the jaws when the draw-rod C is withdrawn. The hardened steel piece which is shaped to fit the casting serves as a stop when placing the work in the chuck.

In a following installment will be described an air-operated stamping press, a milling fixture actuated by compressed air, and an air-adjusted semi-automatic machine, which is unusual in that all the various functions are performed without the use of a single cam, the movements being controlled by compressed air. This installment will be published in May MACHINERY.

* * *

SOUTH AFRICA BUYS MORE AMERICAN MACHINE TOOLS

The imports of machine tools into South Africa in 1925, according to statistics just published by the Bureau of Foreign and Domestic Commerce, were valued at about $270,000, of which the United States furnished machinery to a value of about $70,000, an increase of 64 per cent over each of the two previous years. Lathes constituted the most important item in the South African imports of machine tools, amounting to about $150,000, of which the United Kingdom supplied 75 per cent. Of machine tools other than lathes the United States furnished the larger share, the imports of machine tools outside of lathes being valued at $119,300, of which the United States' share was $66,000. Details of the imports during 1926 are not yet available, but it is stated that the American participation was holding up well, and that the total volume will be about the same as for 1925.

* * *

WHAT HAPPENS IN SHEARING METAL

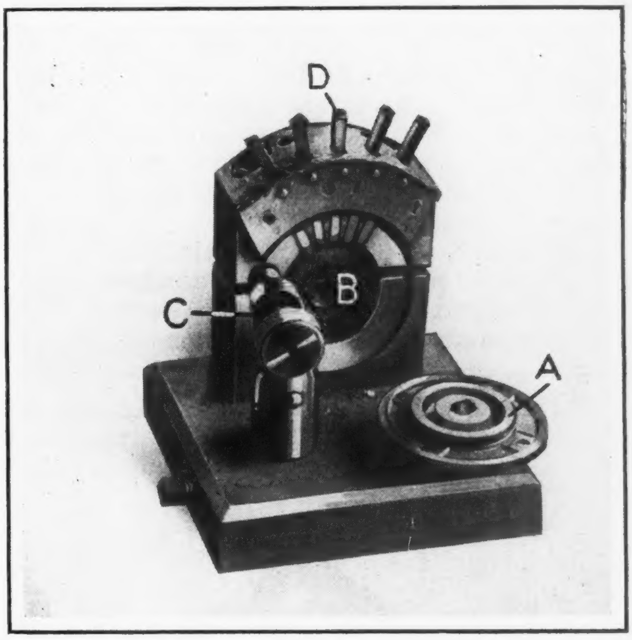
The leading article in May MACHINERY will place on record some unusually interesting results obtained from an analysis of the action of metal in shearing, blanking, or punching. The factors affecting the pressure required for these operations are discussed in this article, which has been prepared by E. V. Crane, staff engineer of the E. W. Bliss Co., Brooklyn, N. Y. Photographs, drawings, and diagrams illustrate the interesting conclusions drawn by the author from his experiments.

FIXTURE FOR NUMBERING PARTS

By AVERY E. GRANVILLE

Most mechanisms are made up of assembled parts that are numbered or lettered in some way so that they can be easily identified in case repairs or replacements are necessary. When the identifying mark is required merely to indicate a certain kind or part, it may be cast on, in the case of sand- or die-cast parts. On other parts, the mark must often be stamped on with steel letters or figures. This is particularly true if the mark is to indicate one of a number of similar machines or devices or is a serial number. Such numbers or letters must be put on in a workmanlike manner, so that the spacing will be even and the line straight. A careful workman, with a good eye, can do this, but it is generally better to provide a fixture of some kind that will insure even spacing.

In the case of the radio part shown in the illustration, a serial number is stamped on the periphery of the secondary disk A. When ready to be



Fixture for Numbering Radio Part

numbered, the flanged disk is placed in the fixture, with the part A in the recess B, the clamp C swung to the right and the thumb-nut tightened in order to hold the piece firmly in the recess and against the face of the fixture. Stamps D bearing the proper numbers are then dropped into the guiding slots and tapped with a hammer. This gives clear even spacing of the nnmbers in a position in which the obstructed view would make it difficult for the workman to space the figures evenly by eye.

* * *

COMPARISON OF EUROPEAN WAGE RATES

According to statistics recently filed in Switzerland and published in the *Swedish-American Trade Journal*, the average hourly wages in some of the leading European countries, expressed in Swiss francs, are as follows: Sweden, 1.79; England, 1.58; Switzerland, 1.51; Holland, 1.29; Germany, 1.25; Austria, 0.95; Italy, 0.84; Belgium, 0.82; and France, from 0.60 in the provincial districts to 0.80 in Paris.

Time-setting Charts for Diversified Work

By EDMUND E. BURKE

TIME study naturally falls into two major divisions—"job study" and "elementary study." Job studies are performed in shops where standardized parts are produced day in and day out. From these studies, standard times can readily be specified for each operation, and the employes paid incentives according to the degree to which they approach the standard times. In shops where jobs are not repeated again and again, however, it is impossible to set standard times on this basis. To enable standard times to be determined intelligently in such shops, it is necessary to make studies of all the elements involved in the ordinary operation of the machines. Studies belonging to this classification are identified by the term "elementary."

The article "Incentive Payment Plan for Diversified Work" which was published in March MACHINERY described the system by which employes in the milling department of the Kent-Owens Machine Co., Toledo, Ohio, are paid an incentive according to their efficiency. As explained in that article, set-up, standard, and allowed times are specified for all jobs in the milling department from charts that were developed after comprehensive elementary studies had been made of every step involved in the operation of each machine. How the information collected was arranged for practical use will be described in this article. ("Routing Diversified Work Through the Shop," another article dealing with the Kent-Owens Machine Co., appeared in February MACHINERY.)

Making the Elementary Time Studies

In making the elementary time studies, the characteristics of all types of machines in the department were carefully analyzed, because the same operation can often be performed on several types of machines. The information collected has been so arranged that the standard time set for the average job will be equally satisfactory, regardless of the type of machine on which the operation is performed.

In the preliminary investigation, all sorts of cuts had to be duplicated on various kinds of metals, and elementary studies had to be made of the time required to open and close all types of work-holding fixtures, tighten and loosen clamps, etc. Numerous studies were also made of the time required to lift parts of various weights and shapes to and from machine tables, and of the time involved in setting up tools and fixtures of all sorts.

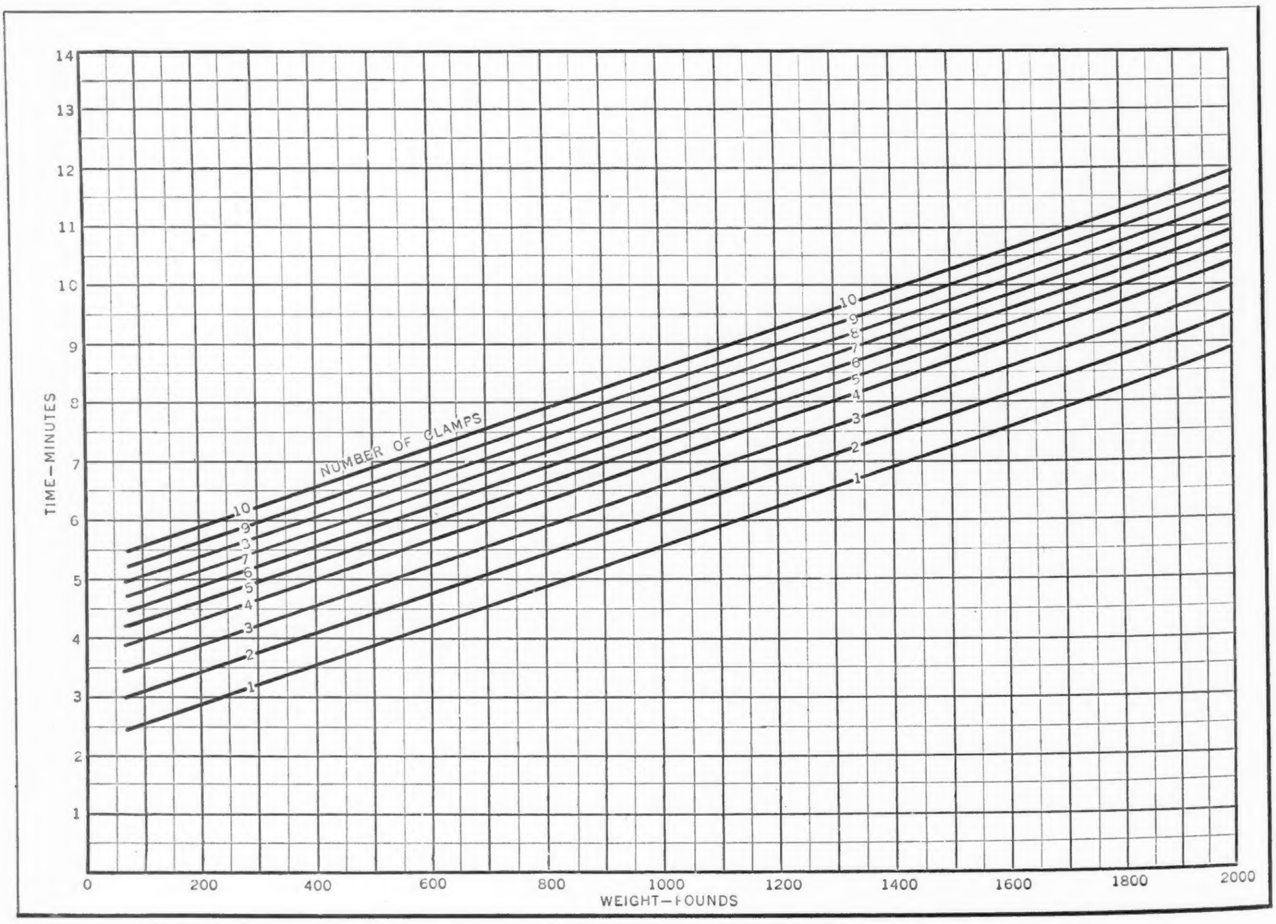


Fig. 1. Chart Used in Determining the Time to be Allowed for Picking Up, Positioning, Clamping, Unclamping, and Removing a Piece

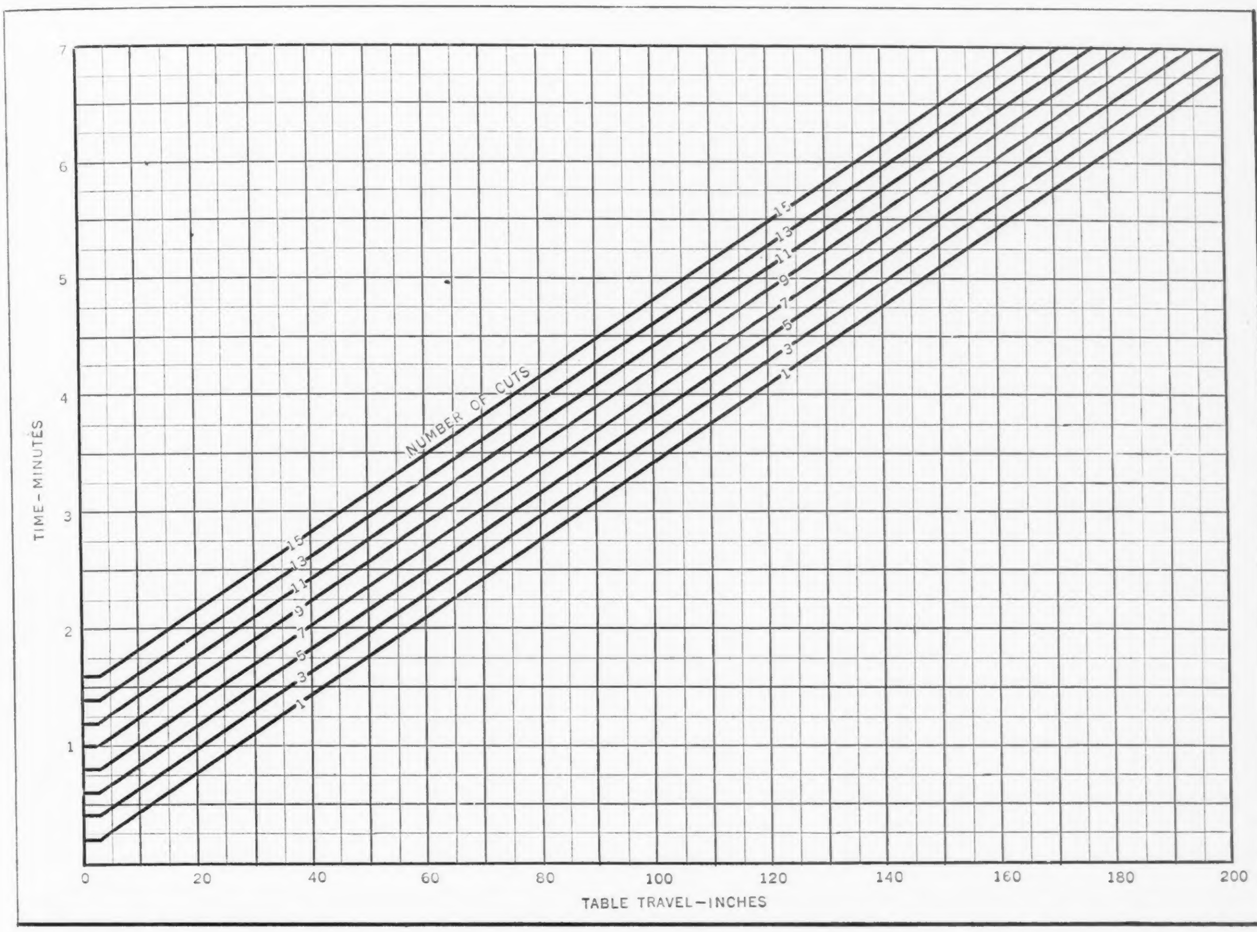


Fig. 2. Chart that Gives the Time to be Allowed for Starting and Stopping the Machine, Engaging and Disengaging the Feed, and Positioning the Table

As explained in the previous article, the standard time for a job is the estimated best possible time in which the job can be done by a good man under good conditions and at a sustained rate throughout the day. The standard time should equal the time consumed in performing each of the elements of the operation plus a certain allowance for fatigue of the operator. It would, of course, be impractical in a shop manufacturing diversified products to calculate closely for every job the time required for each element in the operation. It is for this reason that charts have been developed from which the time required for groups of the elements can be read direct. When the standard time has been decided upon, the allowed time is determined by multiplying the standard time by 1 2/3, as fully explained in the March article.

How the Time-setting Charts Were Developed

Charts have been developed covering every step in the operation of all machines in the milling department on all kinds of materials. Most of these charts combine several related elements, so that in a simple operation requiring about fifteen steps, the time-setter need only refer to perhaps four charts.

In developing the charts, it was necessary to make numerous analyses of typical jobs. To illustrate how the work was carried out, the analysis of a simple milling job will be considered. Assume that a slab milling cut 6 inches wide is to be taken for a length of 60 inches on an iron casting weighing 700 pounds which must be held to the machine table by means of six clamps.

Each element of this operation would be listed in the proper sequence, together with the factor that controls the time of the element, in the following manner:

	Elements of the Operation	Controlling Factor
1.	Pick up piece	Weight
2.	Position piece	(Constant)
3.	Clamp piece (6 clamps)	No. of clamps
4.	Start machine	No. of cuts
5.	Run work to cutter	Distance
6.	Engage feed	No. of cuts
7.	Mill surface	Width, length, and No. of cuts
8.	Disengage feed	No. of cuts
9.	Stop machine	No. of cuts
10.	Run table to starting position	Distance
11.	Free piece	No. of clamps
12.	Remove piece	Weight
13.	Clean table	(Variable)

It will be seen that there are thirteen elements in this operation. In analyzing this job, assume that the weight, rather than the size and shape of the part, is the deciding factor in the time consumed in placing it on the table and in removing it upon the completion of the operation. From the blueprint of the piece, the computer can tell how many clamps should be employed for holding it. A constant is used when the work is held in a machine vise.

All elements having the same controlling factor can be combined as follows, reducing to seven the number of items involved in setting the time for an operation:

Elements of the Operation	Controlling Factor
1. Pick up and remove piece	Weight
2. Position piece	(Constant)
3. Clamp and free piece	No. of clamps
4. Start and stop machine, engage and disengage feed	No. of cuts
5. Free travel of table	Distance
6. Mill surface	Width, length, and No. of cuts
7. Clean table	(Variable)

If two cuts were to be taken on this piece, there would perhaps be twenty-five elements to start with, but these could be condensed to seven items, the same as the thirteen elements.

Constants can be assumed for the time involved in lifting work by hand on a table and in removing it after the performance of the operation, because variations in this time are usually slight. When a chain hoist is employed, however, the time must be specified more accurately. The time consumed in removing the work is always a certain percentage of the time required for lifting it, and so these two elements can be combined for convenience without sacrificing the accuracy of the computation.

The time required to position the work on the table and the number of clamps used for holding the part are also dependent to a considerable extent upon the weight of the piece, and so the elements of "position," "clamp and unclamp the piece" can be combined with "pick up" and "remove the piece." From the data obtained by numerous time studies, the chart illustrated in Fig. 1 was developed to cover all these elements. It will be evident that the time obtained from this chart depends upon the weight of the piece and the number of clamps required for holding it.

The time allowed for the free travel of the table can also be logically combined with the elements of "starting and stopping the machine" and "engaging and disengaging the feed." This has been done in the chart illustrated in Fig. 2, from which the time allowed for these elements is determined. It will be seen that the chart is based on the inches of table travel and the number of cuts required. In developing this chart, a certain rate of table traverse was adopted as constant for all machines. Any error obtained with this constant, when the operation is performed on large machines, is readily absorbed by the long machining time.

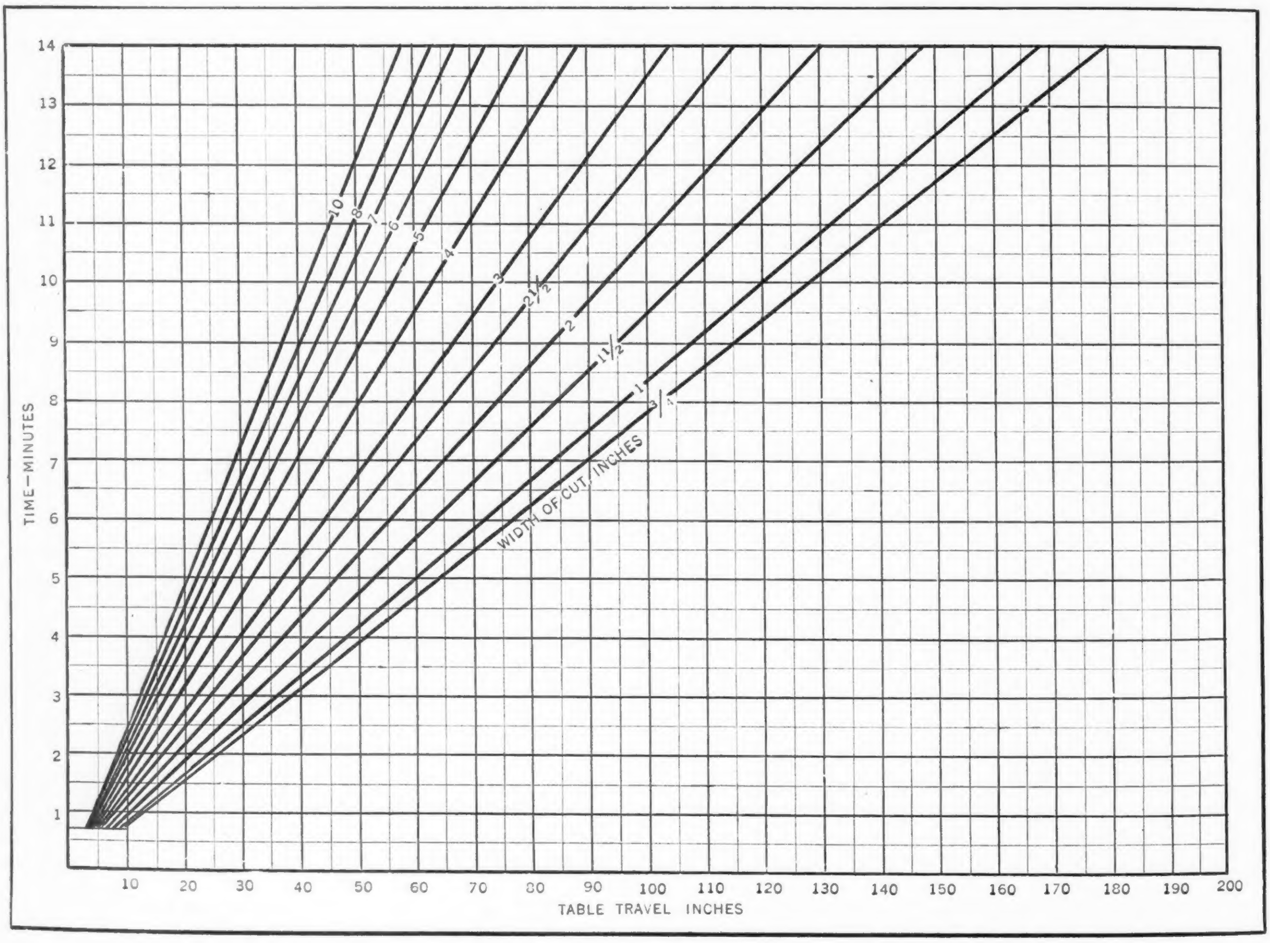


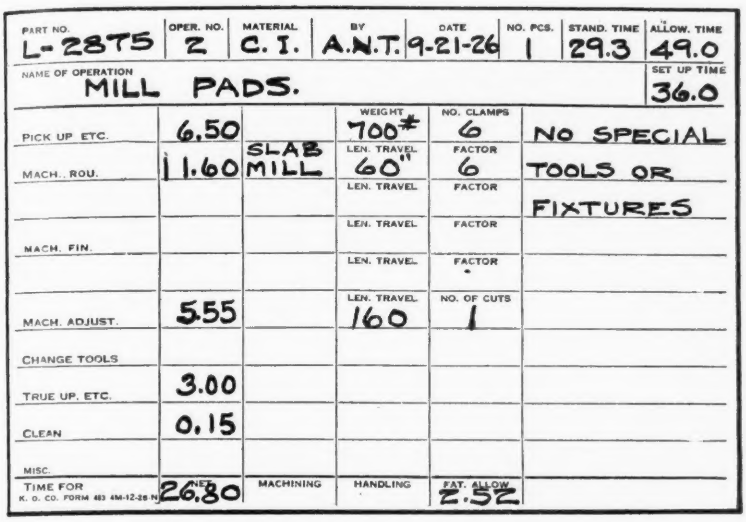
Fig. 3. Chart from which the Time Required for Plain Milling Operations on Iron Castings can be Determined

It will now be evident that the elements involved in the operation have been combined into four items, as follows:

Elements of the Operation

1. Pick up, remove, position, clamp, and free piece
2. Start and stop machine, engage and disengage feed, and traverse table
3. Mill surface
4. Clean table

The time for the third item, that of actually milling the surface, is determined from the chart illustrated in Fig. 3. This chart is based on the table travel in inches and the total width of cut in inches. The time allowed for cleaning off the table is determined by estimate but within given limits. The range for this item is from 0.0 to 0.50 minute.



PART NO. L-28T5 | OPER. NO. 2 | MATERIAL C. I. | BY A.N.T. | DATE 9-21-26 | NO. PCS. 1 | STAND. TIME 29.3 | ALLOW. TIME 49.0

NAME OF OPERATION MILL PADS. | SET UP TIME 36.0

PICK UP ETC. 6.50 | SLAB MILL | WEIGHT 700# | NO. CLAMPS 6 | NO SPECIAL TOOLS OR FIXTURES

MACH., ROU. 11.60 | LEN. TRAVEL 60" | FACTOR 6

LEN. TRAVEL | FACTOR

MACH. FIN. | LEN. TRAVEL | FACTOR

LEN. TRAVEL | FACTOR

MACH. ADJUST. 5.55 | LEN. TRAVEL 160 | NO. OF CUTS 1

CHANGE TOOLS

TRUE UP, ETC. 3.00

CLEAN 0.15

MISC.

TIME FOR K. O. CO. FORM 483 4M-12-26 N 26.80 | MACHINING | HANDLING | FAT. ALLOW 2.52

Fig. 4. Computing Card Used in Analyzing the Jobs

Though this estimate is slightly in error, the total time for the operation is not affected seriously. It should be apparent that at the start of an analysis, there may easily be forty or fifty elements which can be combined into a few items.

Setting the Time for a Typical Job

It must not be thought from the foregoing that it is a laborious procedure to compute the standard, allowed, and set-up times for a job, because a careful analysis of the average job can be completed in approximately five minutes. In determining the times, the computer makes use of the card shown in Fig. 4, which has been filled out to correspond with the routing card shown in Fig. 1 of the February article. On the computing card, the number of pieces is specified as one, because only one piece is machined at a time. The standard and allowed times are both specified for one piece, but the set-up time covers the time required for setting up and tearing down fixtures, tools, etc., for the entire job of twelve pieces.

It will be seen that the standard time equals the net time plus the fatigue allowance. The fatigue allowance depends upon the relation of the machine time to the work-handling time, and is quickly obtained from a graphic chart. The allowed time is equal to 1 2/3 times the standard time. The set-up time is also determined from charts based on data obtained through numerous time studies. By means of the accompanying table, the required over-travel of plain milling cutters can be readily determined.

* * *

What is stated to be the world's largest direct-current motor of 8000 horsepower rated capacity was recently shipped from the Westinghouse Electric & Mfg. Co.'s plant at East Pittsburg. The motor has a total weight of 312 tons. The over-all length of the shaft is 26 feet 8 inches, and the frame has an outside diameter of 20 feet. It is capable of developing a maximum capacity of 2,400,000 foot-pounds, which, at 40 R.P.M., is equal to 18,300 horsepower.

MACHINERY IMPORTS OF EGYPT

The Industrial Machinery Division of the Bureau of Foreign and Domestic Commerce has prepared a report on the machinery imports of Egypt, from which it appears that in 1925, the last year for which complete statistics are available, industrial machinery was imported into Egypt to a value of nearly $8,700,000, of which the United States supplied less than $200,000 worth. The value of the machinery imported from the United Kingdom was nearly $4,000,000; from Germany, $1,350,000; from France, $1,275,000; and from Switzerland, over $1,000,000.

Machine tools represented a very small volume, the total imports being valued at $877,000. Even in the machine tool field, the United States had but a small share, the value being only $1300, as compared with $60,000 worth imported from the United Kingdom, and $65,000 worth imported from Germany. Belgium, France, and Italy also had a much more substantial share in this market than the United States.

* * *

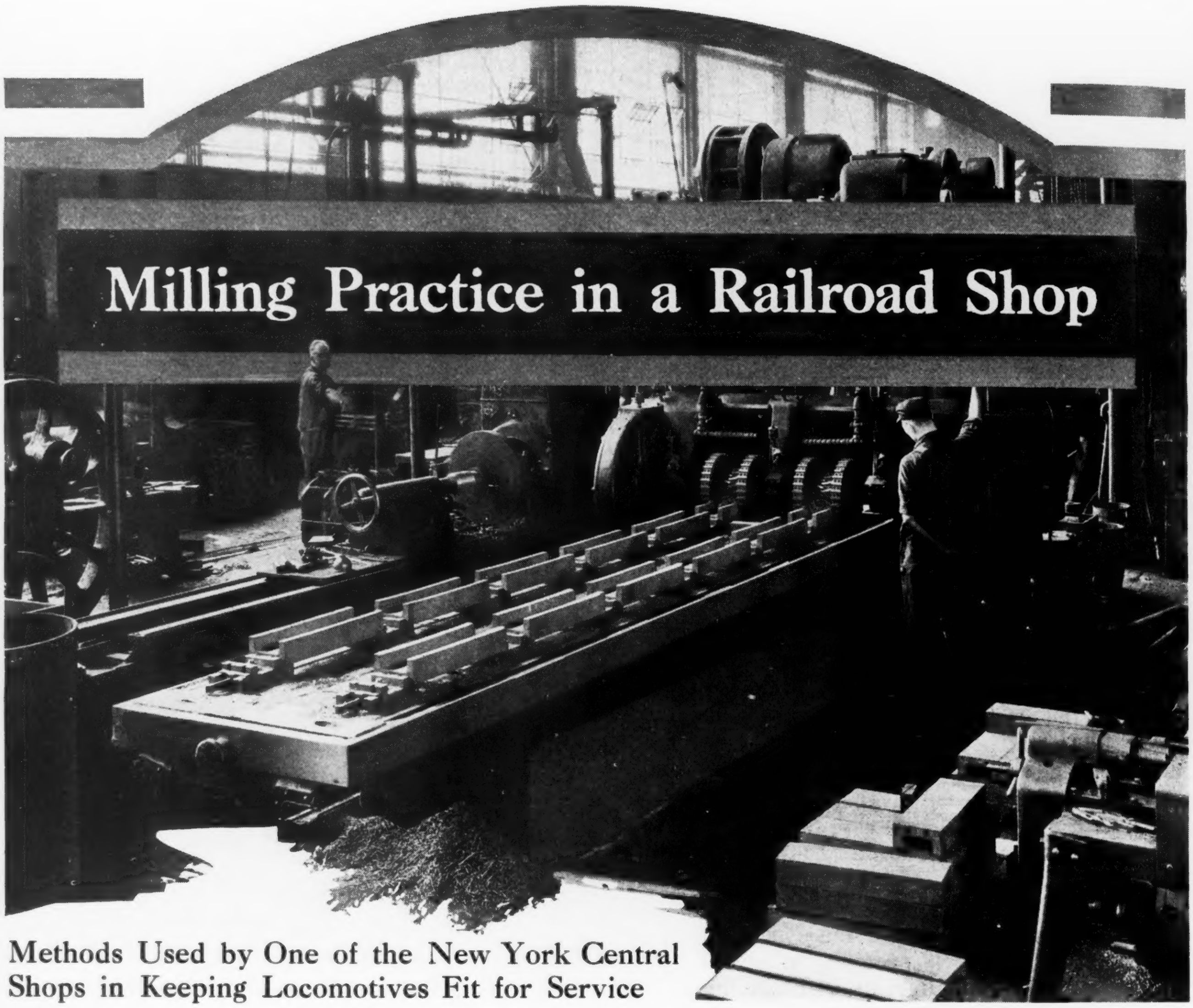
GERMAN INDUSTRIAL DEVELOPMENT

The development that has taken place in Germany since the end of the war is recorded in a statement by Julius Hirsch, professor of economics at Berlin University, in which it is mentioned that the population of Germany has increased 3,500,000 since 1919. The number engaged in industry is 33,000,000, whereas in the area now comprising Germany, according to the pre-war proportion of those so engaged, it would have been only 27,000,000. The number of locomotives per 100 miles of railway has increased 17 per cent since 1913, and the number of passenger and freight cars per 100 miles of track has also increased. There has been a great development in railway traffic. The number of passengers carried in 1925 was 70 per cent greater than in 1913, and the passenger mileage was nearly 100 per cent greater.

Necessary Over-travel of Plain Milling Cutters, in Inches

Depth of Cut, Inches	Diameter of Cutter, Inches						
	1	2	3	4	5	6	8	10
1/8	5/16	1/2	5/8	11/16	3/4	7/8	1	1 1/8
1/4	7/16	11/16	13/16	1	1 1/16	1 3/16	1 15/16	1 9/16
3/8	1/2	3/4	1	1 3/16	1 5/16	1 7/16	1 11/16	1 15/16
1/2	....	7/8	1 1/8	1 5/16	1 1/2	1 5/8	1 15/16	2 3/16
5/8	....	15/16	1 3/16	1 7/16	1 5/8	1 13/16	2 3/16	2 7/16
3/4	....	15/16	1 5/16	1 9/16	1 7/8	2	2 5/16	2 5/8
7/8	....	1	1 3/8	1 5/8	1 15/16	2 3/16	2 1/2	2 13/16
1	....	.....	1 7/16	1 3/4	2	2 1/4	2 5/8	3
1 1/4	....	.....	1 1/2	1 7/8	2 3/16	2 7/16	2 15/16	3 5/16
1 1/2	....	.....	......	1 15/16	2 5/16	2 1/2	3 1/8	3 9/16
1 3/4	....	.....	......	2	2 3/8	2 3/4	3 15/16	3 13/16
2	....	.....	......	....	2 7/16	2 7/8	3 7/16	4
2 1/4	....	.....	......	....	2 1/2	2 15/16	3 5/8	4 3/16
2 1/2	....	.....	......	....	....	3	3 11/16	4 5/16
2 3/4	....	.....	......	....	....	3	3 13/16	4 7/16
3	....	.....	......	....	....	....	3 7/8	4 9/16
3 1/4	....	.....	......	....	....	....	3 15/16	4 11/16
3 1/2	....	.....	......	....	....	....	4	4 3/4
3 3/4	....	.....	......	....	....	....	4	4 13/16
4	....	.....	......	....	....	....	....	4 7/8

Milling Practice in a Railroad Shop



Methods Used by One of the New York Central Shops in Keeping Locomotives Fit for Service

MACHINE operations in railroad shops usually cannot be performed on a production basis, because the average part is run through the shops in such small lots as not to warrant time- and labor-saving jigs and fixtures. Most work, therefore, must be handled on a sort of jobbing shop basis. There are some parts, however, such as pedestal shoes and wedges, which have been so standardized that they can be machined in fairly large quantities and kept in stock until needed. Also, adjustable jigs and fixtures may sometimes be so designed as to accommodate several sizes of a part.

In the West Albany, N. Y., maintenance shops of the New York Central Railroad Co., efforts are constantly directed toward the application of the most up-to-date machine shop methods in keeping locomotives fit for service. This article will describe several examples of efficient milling practice in the shop mentioned.

Finishing Cross-head Guide Shoes

Fig. 1 shows the operation of milling the guide shoes of locomotive cross-heads. By means of fixture *A* and arbor *B*, two cross-heads can be lined up accurately for machining the shoes with one set-up. Arbor *B* is tapered at each end to suit the tapered piston-rod hole in the cross-heads; hence, a cross-head can be mounted on both ends of the arbor in the manner illustrated at *C*. The arbor is supported in vees in fixture *A* in order to hold the two cross-heads in proper alignment on the table of the milling machine. At the end opposite the arbor, each cross-head is supported on the bottom face by a special screw jack which has a tongue that is fitted to the central T-slot of the table.

The shoes *D* of the cross-head are Hunt-Spiller gun-iron castings, and are bolted to the cross-heads before the latter are fastened on arbor *B*. In an operation, surface *W* of each shoe is milled by the cutter of the rail-head while surfaces *X*, *Y*, and *Z* are being milled by the cutters mounted on the corresponding side-head.

Surfaces *X* are about 1 1/2 inches wide on the example shown, and surfaces *Y*, 10 inches wide. Cutters 5 inches in diameter are mounted on the side-heads so that surfaces *Y* may be finished by two forward movements of the table past the cutters, the lower half of the surfaces being milled during the first table movement and the upper half and surfaces *Z*, during the second movement. While the lower half of surfaces *Y* is being milled, the cutter of the rail-head is employed for milling surface *W* on the left-hand shoes, and when the upper half of surfaces *Y* is finished, the rail-head cutter is employed for milling surface *W* on the right-hand shoes.

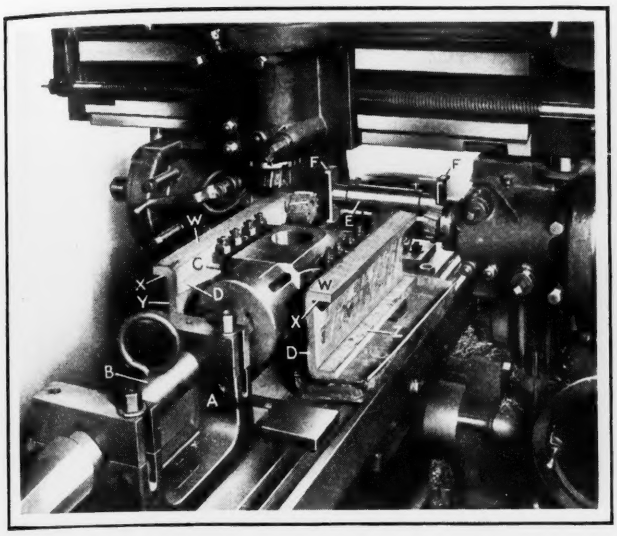


Fig. 1. Milling Four Surfaces of the Shoes of Two Cross-heads Set up in Tandem

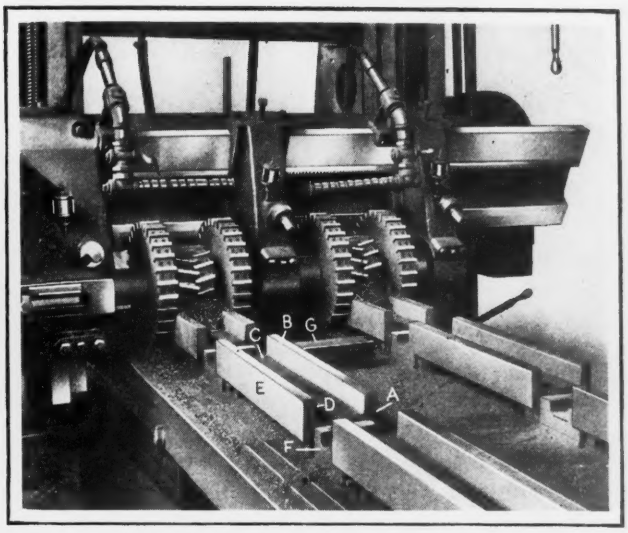


Fig. 2. Milling Pedestal Shoes on a Quantity Production Basis, Using Eight Cutters

Accuracy of the operation is insured and the operation is expedited by the use of the special cutter-setting device shown at *E*. This device consists primarily of a stand fastened to the machine table, which has a horizontal arbor provided at each end with a cutter-positioning member *F*. The space between the two major vertical faces of members *F* corresponds to the desired distance between surfaces *Y* of the two shoes of a cross-head, so that this distance can readily be obtained by bringing the cutters of the side-heads against the surfaces of the gaging device.

Members *F* are also provided with ledges at the top and bottom against which the periphery of the two side-head cutters is set to insure milling surfaces *X* and *Z*, respectively, in the proper locations. All three cutters are of the end-mill type, have helical stellite inserted blades, and were made by the Production Tool Co. From 1/8 to 1/4 inch of stock is removed from each surface, using a feed of 8 inches per minute and a cutter speed of 64 revolutions per minute.

Hunt-Spiller gun iron is used considerably in locomotive construction not only for cross-head shoes, but also for pedestal shoes and wedges, cylinder bushings, piston-rings, valve bushings, and other parts. This metal has a much higher tensile strength than ordinary iron castings, and has properties that make it desirable for use where parts are subjected to superheated steam and extreme frictional wearing conditions. It is an air-furnace charcoal iron which was long used in the construction of ordnance before being adopted by locomotive builders. The Hunt-Spiller Mfg. Corporation, South Boston, Mass., markets standard parts cast from this metal.

Machining Pedestal Shoes and Wedges in Quantities

Pedestal shoes and wedges are finished on the large planer-type milling machine shown in the heading illustration and in Fig. 2. Twelve shoes or wedges are ordinarily loaded on the table at one time. In the operation on the shoes, four Production Tool Co.'s cutters with inserted stellite blades operate simultaneously on each shoe and finish surfaces *A*, *B*, *C*, *D*, and *E*. Surfaces *A* and *E* are finished by the two large cutters, which are 16 inches in diameter, and surfaces *B*, *C*, and *D*, by the two smaller cutters, which have a diameter of 9 inches.

The shoes are iron castings, and about 1/8 inch of stock is removed from each surface, with a table feed of 7 1/2 inches per minute and a cutter speed of 24 revolutions per minute. The production on this job averages seven table loads of shoes per eight-hour day.

To facilitate clamping the shoes to the table of the milling machine in proper alignment with the cutters, two 1/2-inch holes are drilled in each end of the shoes before they are delivered to the machine. These holes may be seen in one shoe of the pile in the foreground of the heading illustration. When the shoes are placed on clamping units *F*, Fig. 2, which are bolted to the machine table, two sliding studs of the clamping units are advanced into the holes in the shoes to hold the shoes in proper alignment with the cutters. The studs are advanced and withdrawn by merely applying a wrench to a nut in the middle of units *F*. The studs are contained in adjustable blocks which support the shoes and which may be easily raised or lowered to bring the shoes to the desired height above the machine table.

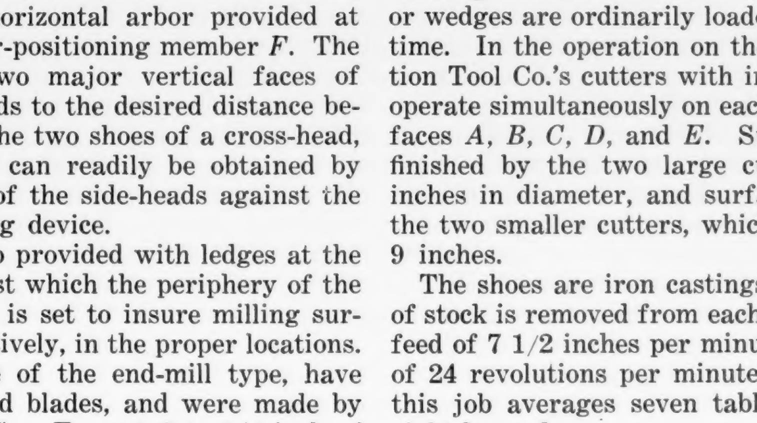


Fig. 3. Cross-head Guide Being Milled Preparatory to Grinding

At *G* is shown an adjustable wedge used in checking this height.

Milling Cross-head Guides and Connecting-rods

Cross-head guides, main-rods, and side-rods are usually milled on all four sides to snap gages, on the planer-type milling machine shown in Fig. 3. It is also the practice to mill the channels in connecting-rods on this machine. In the illustration, the machine is shown set up for milling a guide that is accurately located on centers. The guide rests on three adjustable screw jacks, such as shown at *A*, and is braced sidewise by means of four screw-actuated blocks *B*. Six Goddard & Goddard slab milling cutters, 10 inches in diameter, with inserted helical high-speed steel blades, are mounted on the machine arbor. While the illustration shows only one guide on the machine, two guides are regularly milled at a time.

Before the operation, whiting is painted on all four sides of the guide or connecting-rod, as the case may be, and the finished outline of the part is next accurately scribed. Then, after the part has been set up on the machine, it is an easy matter to mill it to the desired outline. One cut is taken on each surface, milling off about 1/4 inch of stock. As the parts are steel forgings, the feed of the table is about 10 1/4 inches per minute, and the speed of the cutter, 24 revolutions per minute. Coolant is used copiously in this operation.

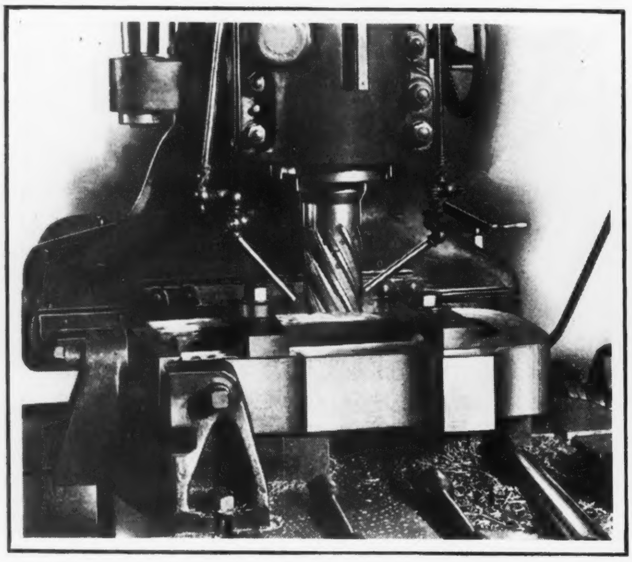


Fig. 4. Milling the Contour of a Large Main-rod Strap on a Vertical-spindle Machine

How the Contour of Main-rod Straps and Similar Parts is Produced

Main-rod straps, the ends of main- and side-rods, eccentric cranks, and other parts are milled to the desired outline on the vertical-spindle milling machine illustrated in Fig. 4. The spindle head of this machine is adjustable horizontally to and from the center of the rotary table; this construction permits of milling to practically any required shape.

Ends of work are milled to a large radius by setting the surface the necessary distance from the center of the table and then rotating the work past the cutter. Outlines of small radius are produced by manipulating the spindle head horizontally toward or away from the work as the table rotates. This movement is accomplished through a hand mechanism. Parts handled on this machine are also first covered with whiting and the contour laid out. The parts are steel forgings.

Only one cut is taken around the part, and so the depth of the cut may vary from 1/4 to 1 inch. During a 1-inch cut a feed of from 1 to 2 inches per minute is employed, with a cutter speed of about 33 revolutions per minute. The cutter, which was made by the Ingersoll Milling Machine Co., is 5 inches in diameter, 12 inches long to permit machining the entire width of cross-head guides, and is provided with inserted helical blades of high-speed steel. In operations on main-rod straps, two straps are often set up on the table at one time to be milled simultaneously.

Plain milling machines are used extensively for slab-milling miscellaneous parts, such as radius bars and combination levers. Fig. 5 shows a typical operation, in which the cutter is of the helical type, 2 1/2 inches in diameter and 5 inches long. Goddard & Goddard cutters are used in these operations.

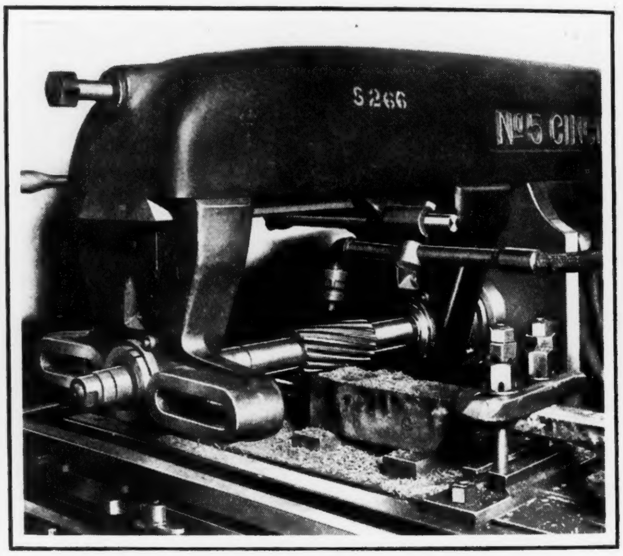


Fig. 5. Typical Slabbing Operation Performed on Plain Milling Machine

* * *

CANADA'S MACHINERY OUTPUT LARGER

The production of machinery in Canada is increasing, according to a statement issued by the Dominion Bureau of Statistics at Ottawa, referred to in a recent number of *Commerce Reports*. The output of the Canadian machinery industry in 1925, the last year for which complete statistics are available, amounted in value to $30,500,000, an increase of about 5 per cent over the previous year. One hundred fifty-one machinery builders are covered by the statistics, of which 111 were located in the Province of Ontario, 25 in Quebec, and 10 in British Columbia, the others being scattered over the other states. The capital invested exceeds $55,000,000, and the industry employs approximately 8300 people. The leading classes of industrial machinery manufactured are paper mill machinery, pumps, and woodworking machinery. Other leading lines of manufacture are elevators, water wheels and turbines, and mining machinery.

METAL GROWTH CAUSES MOTOR STARTER TO FAIL

By DONALD A. HAMPSON

An instance in which a motor starter that had stood idle for a time failed to work, as a result of "metal growth" in one of the parts, will be of interest to those who may encounter the same puzzling trouble in the case of motors that are allowed to remain idle for a long time. The motor in question operated on a 220-volt alternating-current circuit, and had a given amount of work to handle at certain seasons. In making new installations, the machines in the department were equipped with individual motor drives, which proved more economical, as they stand idle five or six months in a year.

The time relay panel, which controls the no-voltage release of these installations, has two circuit-breakers, the movement of which is stabilized through dashpots. The dashpots are white-metal die-castings, 1 1/2 inches in diameter and depth, inside of which there are pistons 1/2 inch long, also made of white metal. The movement of these pistons, which is vertical, is retarded by the passage of the transformer oil through the perforations in the disk end of the pistons, and by the natural oil friction along the wall surfaces.

When these particular installations were first made, they operated perfectly. The irregular action commenced when the machines were started up after an idle period of six months. In one case, the motor could not be stopped until the line switch was pulled. It was realized that some misadjustment or change had taken place, and the shop repairman undertook to locate the trouble. The search finally led to the dashpots which, it was found, could not be moved manually. The dashpot and plunger were removed and taken to the bench, when, to the surprise of the workman, it was found that it was impossible to separate them by ordinary means. In the end, the separation was effected by using a clamp made to grasp the dashpot cup without distorting it, heating the exterior quite hot in a gas flame, and using a pry to draw the piston out quickly. Even this method was not successful until cold water was poured inside the piston to cause the walls to contract.

When the various parts had cooled to atmospheric temperature, they were carefully measured, which disclosed the fact that the piston was 0.003 inch larger than the inside of the dashpot. The piston was then turned down 0.005 inch to make it a running fit and to allow for an oil space. When reassembled, the starter worked as well as ever, and has given no further trouble.

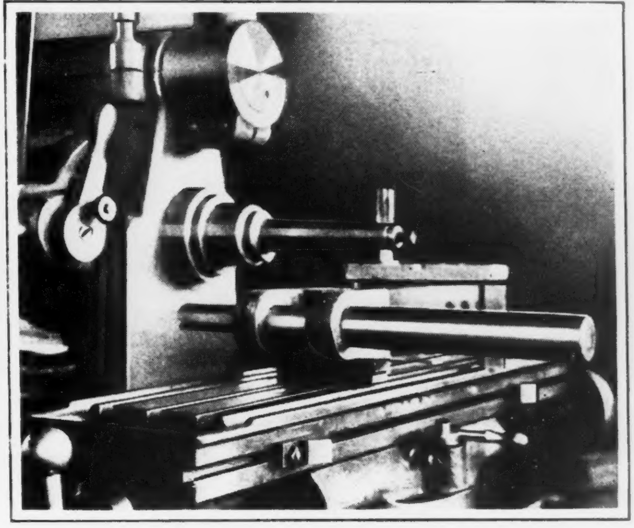
It is well known that white metal parts change size under atmospheric conditions, in much the same manner as iron castings, and the instance referred to emphasizes this characteristic. It is possible, of course, that something about the action of the oil aided in the marked change that took place in the metal of the dashpots. Another point worth mentioning in connection with such mechanisms is the desirability of maintaining the proper oil level. It is sometimes thought that the action of the pistons will be satisfactory if the cups are not full of oil, as long as the pistons are well covered. However, this is not the case, as the balance of the parts and the overload setting is made for a certain weight of oil above the piston, which is as necessary as the ports to retard certain movements. Hence, losses of oil from drying up, inspection, etc., should be made up, and the oil kept at the original height near the top.

* * *

SETTING ECCENTRIC BLADES FOR FACING JAWS ON MILLING MACHINE

By J. R. PHELPS, San Bernardino Shops, Atchison, Topeka & Santa Fe Railway, San Bernardino, Cal.

After the taper pin holes have been bored and reamed in the forked ends of eccentric blades, the jaws are faced on a milling machine. In order to set the axis of the pin hole parallel with the axis of the machine spindle, a mandrel is used having a tapered end which fits into the pin hole and a cylindrical or straight section which may be set level and square with the machine bed. (See illustration.) In facing the inner surfaces, the cutter



Eccentric Blade and Special Mandrel Used in Setting it Square with Milling Machine Table for Facing

is placed in position after the end of the bar has passed through one side.

The use of the taper mandrel makes it possible to set an eccentric blade accurately, even though the pin hole is the only finished or accurate surface. Moreover, this method of facing is faster and more accurate than the slotting method often employed.

The tool-holder used for this operation, and also for other boring and facing operations on the milling machine, differs from the usual tool-holder in that it has an enlarged end that is threaded to fit the nose of the milling machine spindle, which provides a rigid support.

* * *

MAKING MILLING MACHINE ARBORS

The methods used in making milling machine arbors on a production basis will be described in an article to be published in May MACHINERY. Accuracy and adequate strength and durability are the prime requirements in satisfactory milling machine arbors. The article explains how one manufacturer obtains these results by standardizing his production methods and instituting rigid inspection tests to insure that specifications are met.

Methods of Holding Tools and Cutters

Fourth of a Series of Articles

By FRED HORNER

THE split type of holder is satisfactory for a variety of tools. It is of simple construction, consisting of only a few parts. This method of clamping tends to give the effect of a solid part, and in many cases reduces vibration. The split type of clamp may be used alone or with some kind of adjusting screw.

The split member may be spread apart by a wedge or contracted by a screw or collar. The wedge method is used chiefly on boring or facing heads having from three to six blades, each split member serving to clamp one blade, as shown at *A*, Fig. 20, while in milling cutters having more blades, one wedge is often used to clamp two cutters in place, as shown at *B*. In some cases, even a greater number of blades may be secured by one wedge, as for instance, in the Disston inserted-tooth milling saw, a section of which is shown at *C*. Here there is one wedge for every six teeth.

The split fastening gives good service when there is not sufficient room at the end of a bar to accommodate a set-screw, as in the case of the holder shown at *H*. This construction is also well adapted for holding radius forming cutters, such as shown at *D*, which must be rigidly attached to the holder. Some dovetail forming tools are also held in split holders, as shown at *E*.

Various holders with forming tools mounted in multiple are employed, especially for automobile work, such as forming, turning, grooving, and radius turning. One holder is often fitted with several forming cutters, the positions of which are not changed after the ends are sharpened. Many cutters or blades of this type might be shown, but the one at *F*, Fig. 20, will serve to illustrate the general design.

In some cases, a tool for forming curves is placed at the side of a plain straight tool, both pieces of steel being clamped by a single split V-member. Such tools are frequently mounted in the same rests or blocks as ordinary holders or solid tools. At *A*, Fig. 21, is shown a plan and section view of a prismatic split grip holder used for threading purposes or light forming operations. The back of the cutter has serrations and is prevented from slipping by a serrated strip resting in a slot. This design is made by Hotchkiss, Coventry, England.

Split Type of Holder for Various Styles of Cutters

The split holder receives considerable favor as a means for holding thin blades for parting and grooving operations. In some instances, the split member is closed on the blade only by the pressure of the clamping plate or toolpost screw, while in other cases, one or two screws are employed. A screw is used as shown at *G*, Fig. 20, for the Acme screw machine equipment, and this method is favored for securing round boring bars and tools either in a simple post or on the complex outfits of a turret lathe or multi-cutting lathe.

One side of a Hartness turret, shown in the elevation view at *D*, Fig. 21, has three split bar

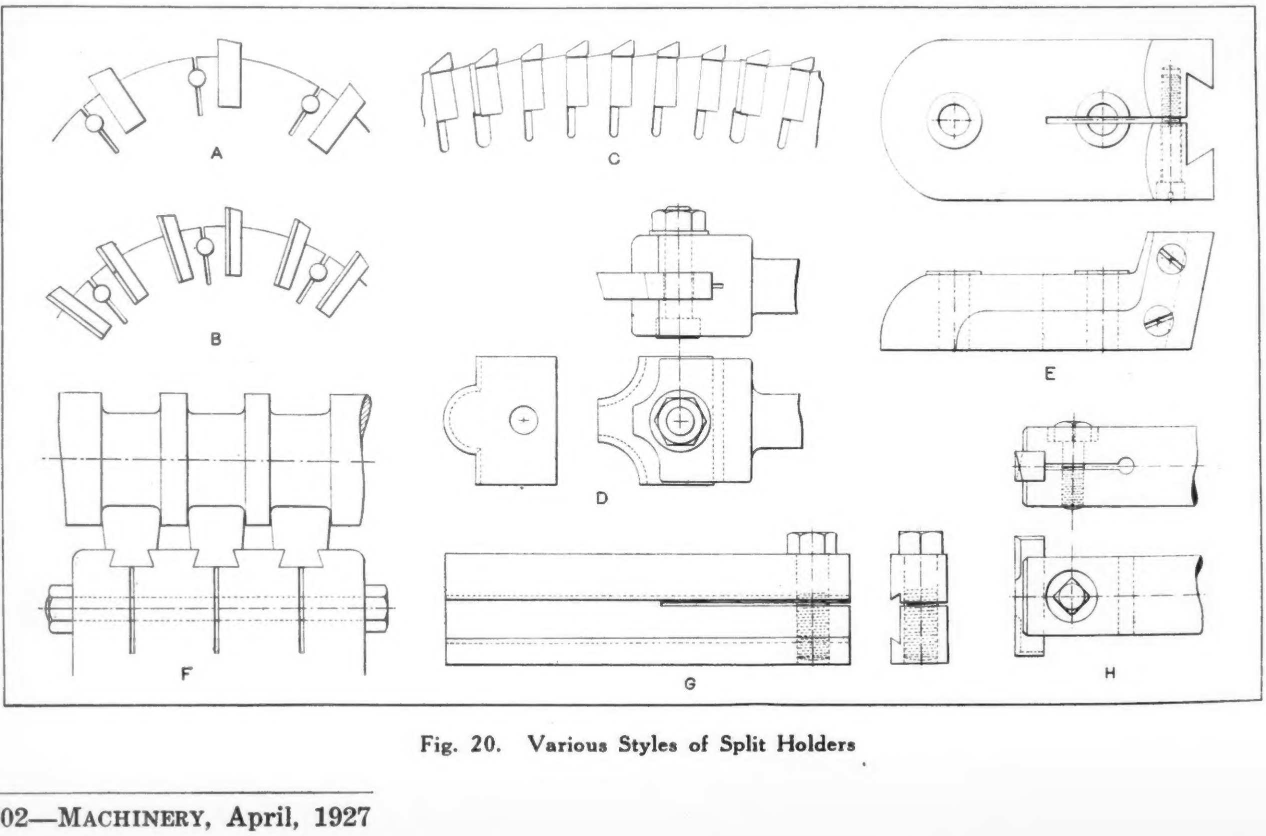


Fig. 20. Various Styles of Split Holders

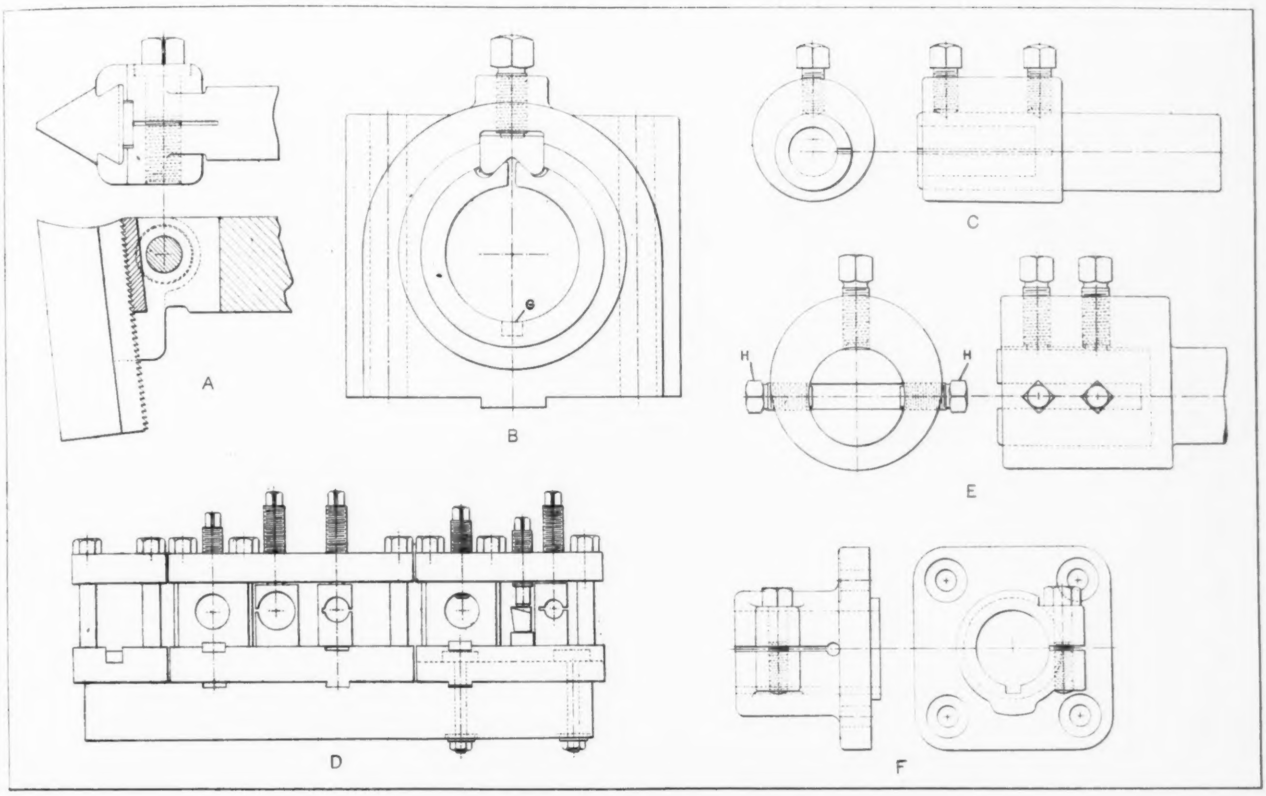


Fig. 21. Further Examples of Holders of Split Construction

holders. A clamp of somewhat different construction is shown at *B*, which has a split interchangeable bushing contracted by a wedge-block and set-screw. A keyway can be cut at the bottom, as shown by the dotted lines at *G*, to prevent circular slippage or to insure setting certain types of tools in their correct positions.

The split type of clamp is not used to any great extent for tool-holders or extension arms that are bolted to turret faces, because the holder or arm is weakened too much to withstand the cutting pressure at the end of a long holder. For this reason, the type of holder shown at *F*, Fig. 21, is not so desirable nor so extensively used as the solid design provided with set-screws or a binder bolt. The lever effect, when long bars are used in the type of holder shown at *F*, obviously exerts considerable pressure on the split holder, which has a

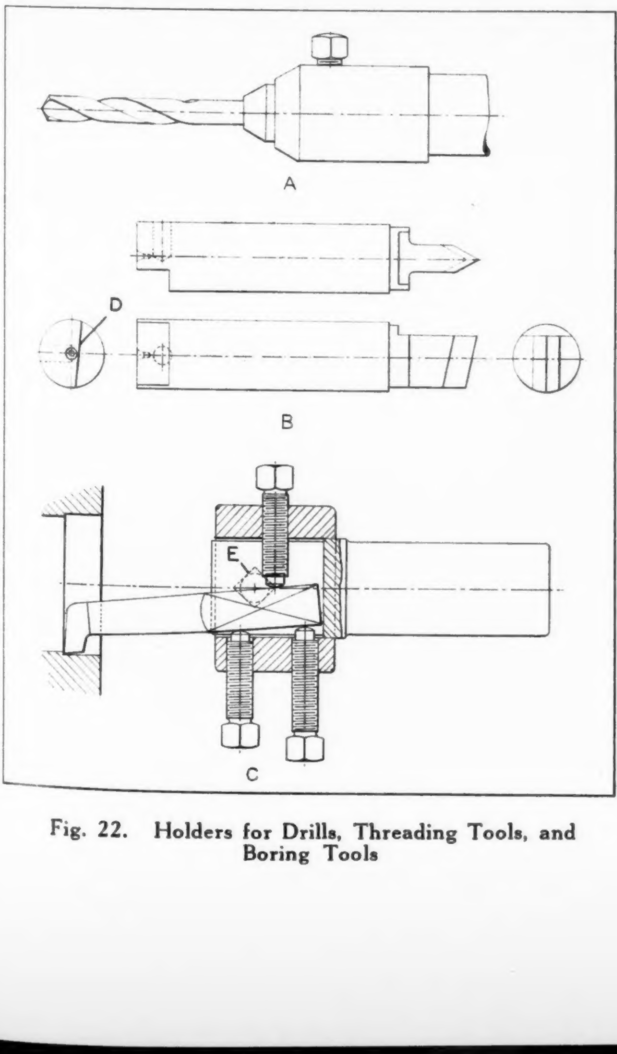


Fig. 22. Holders for Drills, Threading Tools, and Boring Tools

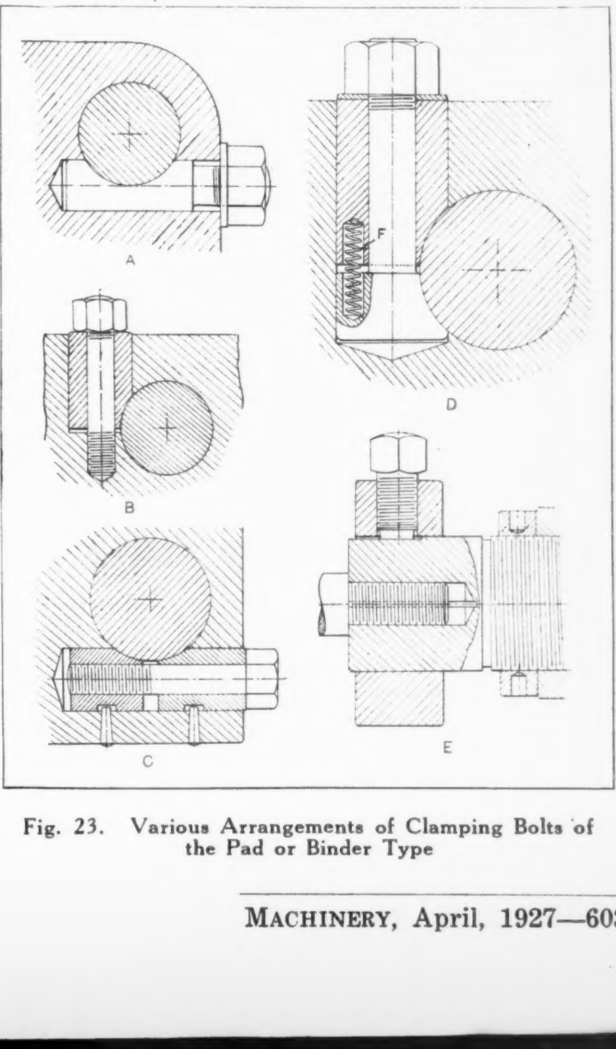


Fig. 23. Various Arrangements of Clamping Bolts of the Pad or Binder Type

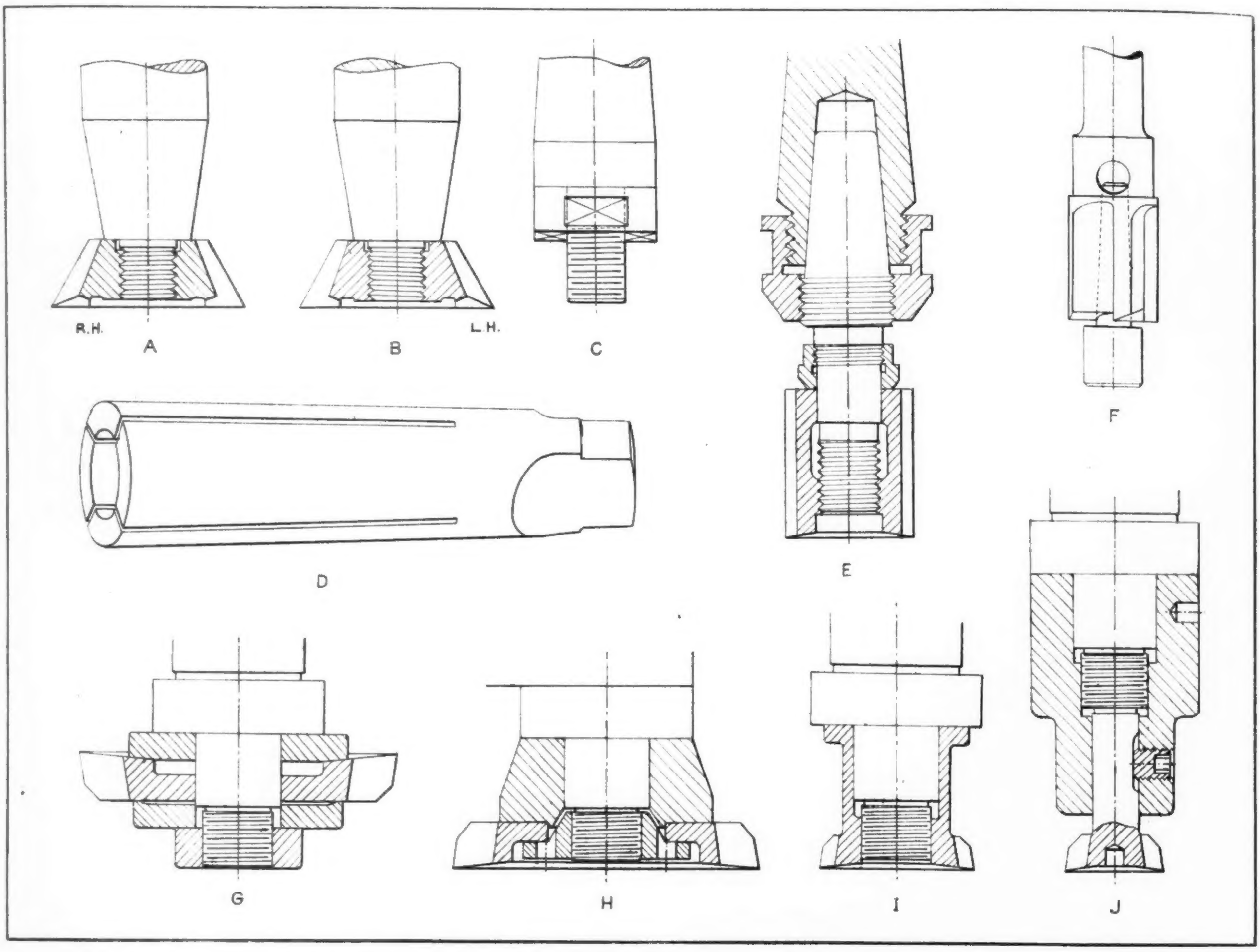


Fig. 24. Threaded Arbors for Milling Cutters; Split Taper Socket; and Cutter with Taper Shank Pilot

tendency to loosen the grip. However, small holders for tap drills, counterbores, reamers, facing tools, etc., give excellent service when equipped with split type clamps.

The clamping action may be obtained as shown at *C*, Fig. 21, by a set-screw in a sleeve placed at the front end of the holder or by means of a split removable bushing inserted in the holder, as shown at *E*. Lateral adjustment for centering the tool may be obtained by means of set-screws *H*. Taper shank tools, of course, require a bushing bored out to fit the taper of the tool.

At *A*, Fig. 22, is shown a drill holder and bushing employed on the Acme automatic screw machine. The end of this holder, as well as the bushing, is turned to a cone shape in order to permit the chips to flow freely from the drill flutes. In some cases, where it is desired to obtain variations in the lateral position of the tool, the hole for the clamping bushing is made eccentric with respect to the shank of the holder. The desired setting may then be obtained by rotating the holder or the bushing.

This method is used to obtain the proper height adjustment of the threading tool on a precision lathe made by Alfred Herbert, Ltd., Coventry, England. As the shank of the tool-holder is round, the holder can be revolved a sufficient amount to bring the cutting edge into the correct angular position for threading, before tightening the clamping screws. A flat, as shown at *D*, in view *B*, is ground on the rear end of the tool, which serves as a guide in setting the cutting face to the correct angle. A small square is placed on the slide-rest, and the tool revolved until the flat *D* is in a vertical position, or parallel with the vertical edge of the square.

A considerable range or variation in the setting of the tool is possible with the type of split holder shown at *C*, Fig. 22. A holder of this type is employed by the Warner & Swasey Co. for setting forged cutters for boring operations. The three set-screws shown in the cross-sectional view are employed to make the lateral adjustment, after which the slotted body is closed on the tool or cutter by set-screws positioned at right angles to the adjusting screws, one of which is shown by the dotted lines at *E*.

Clamping Bolts of the Pad or Binder Type

Bolts of the pad or binder type provide a powerful grip without danger of marring or crushing the threaded member. They are used extensively for clamping the shanks of tools in turret holes and for securing tool-bars in turning and facing heads. In the case of tools that are subjected to severe twisting stresses, the shank of the tool may be keyed in place, as well as clamped by the binding bolt.

A simple solid bolt clamp for a tool-bar is shown at *A*, Fig. 23, and a bushed type of bolt at *B*, while a double bushing type is shown at *C*. The latter type of bolt provides a larger gripping surface, but is more complicated. The type of bolt generally considered the best, especially for use on turrets, has the curved binding surface at one side and the

matching bushing at the other, as shown at *D*. A spring *F*, placed in holes drilled in the two clamping members, serves to separate the clamping members and release the tool shank when the clamping nut is loosened.

Cutters with Threaded Shanks or Holes

There are very few tools designed to be held in place by threads cut directly on the tool. Small end-mills, such as shown at *A* and *B*, Fig. 24, are among the principal types that depend upon threads cut directly on the tool as a fastening means. The threads must be made right- or left-hand according to the direction in which the spindle or arbor rotates.

The means for loosening or removing the cutter is an important point to consider in designing cutters with the threaded type of fastening. This problem has been given careful consideration in designing the clutch type of arbor shown at *C*, which permits the cutter to be rotated by a wrench applied to the loose collar. Cutters screwed on a plain arbor, as shown at *E*, are seldom used, while the direct mounting of large cutters on spindle noses has been discontinued to a considerable extent in recent years in favor of plain parallel or taper mountings with positive clutch drives. The latter type give no trouble from freezing, as is the case with threaded cutters when they are tightened up on the arbor.

Some of the methods employed by the Fellows Gear Shaper Co., Springfield, Vt., for securing the cutters to the spindle are shown at *G*, *H*, *I*, and *J*. In the case of broaches, the ends of the broaches are often fitted to the draw-bar heads by a split threaded joint and binding collar, as shown at *E*, Fig. 23.

Designs of Taper Fastenings

A tapered grip has the important advantage of automatically taking up looseness and obtaining a good grip without loss of concentricity. The taper fit, when combined with a tang, key, or clutch gives a positive drive. For many purposes, the friction grip of the taper alone is sufficient to meet the requirements of small drills, milling cutters, etc. The gripping or driving power of the taper socket can be greatly increased by slitting the socket, as shown at *D*, Fig. 24. This type of socket may be used to drive a tangless drill.

A plain taper, such as is used for the pilot of the counterbore shown at *F*, is sometimes satisfactory, but in most cases a pin, key, or tang at the large end of the taper is required. A Woodruff key is commonly used for this purpose, but a rectangular key *F* can be employed, as shown in view *A*, Fig. 25. This construction is used on the milling machines made by George Richards & Co., Ltd., Manchester, England. As a draw-bolt cannot be conveniently used to hold the socket in place, a screw *G*, set at an angle, as shown, is incorporated in the holder.

The clutch type of drive shown at *D*, with a

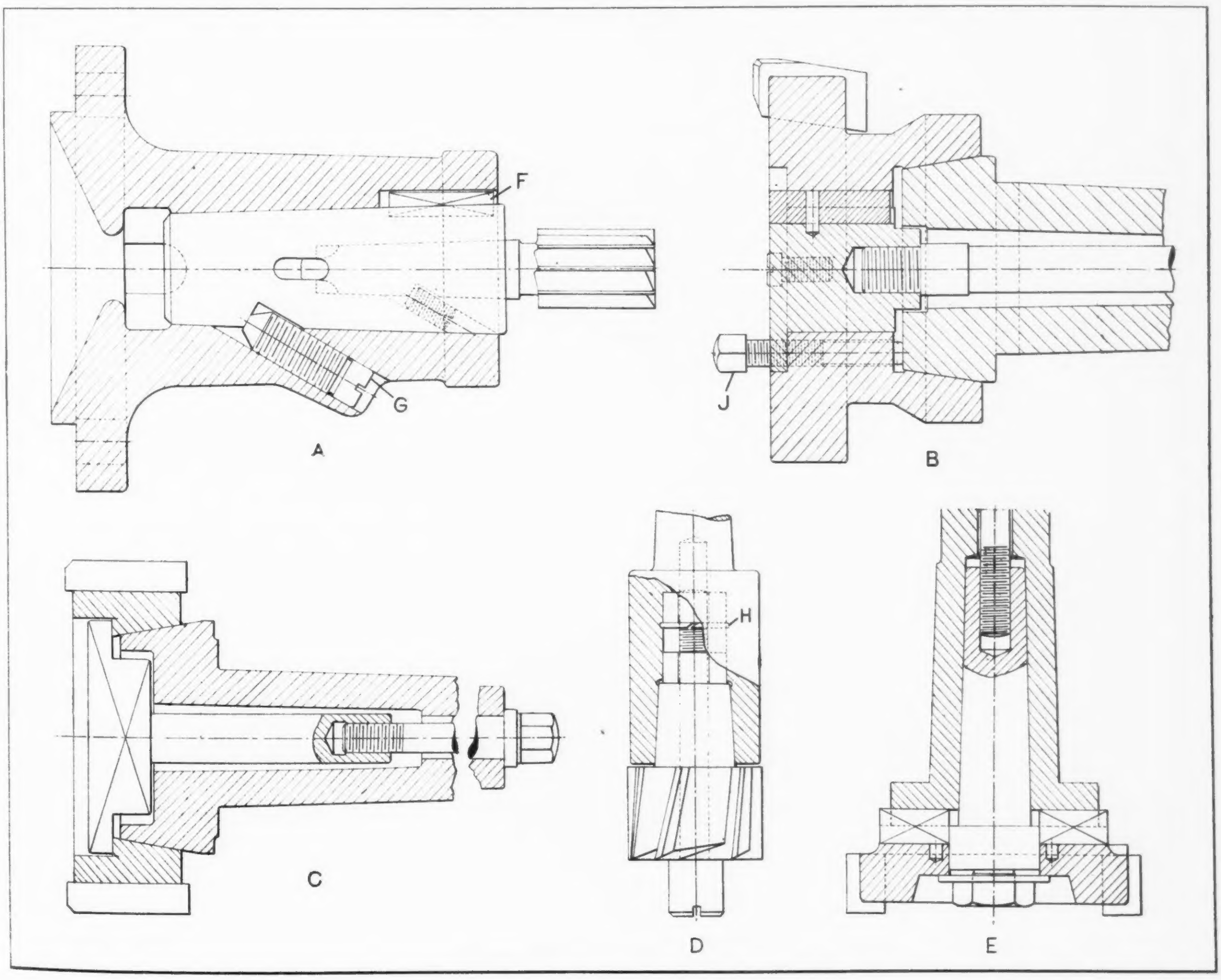


Fig. 25. Holders of Taper Nose and Clutch Drive Types

hexagonal driving section machined at the end of the stem, is employed on the Gairing Tool Co.'s counterbores. With this method of driving, the hexagonal nut in the top of the socket is held in place by spring *H*, thus enabling the pilot to be screwed into place. Clutch teeth are generally machined at the front end of the taper to eliminate the heavy torque on the arbor or shank. Some of the large twist drills are clutch-driven, as are a great many kinds of milling cutters that require a positive drive.

If the spindle nose has a cross-slot, the arbors and cutters are simply flattened to fit the cross-slot, but the face cutters have projections on the back, or separate hardened keys are fitted into grooves milled in the tool, as in the case of the Ingersoll mounting shown at *E*. A similar drive is furnished for the plain centering shanks when the cutter is held to the spindle by collar screws.

Drives Designed to Eliminate Freezing

In some of the recently designed milling machines, the spindle noses have external tapered ends which eliminate the freezing of the tool on the spindle, as often occurs with the threaded type of nose when heavy pressures are imposed on the tool by high-speed cutting. The tapered portion insures proper alignment of the tool with the machine spindle, and a box type clutch provides a positive drive.

The driving member may be a separate part, as in the case of the Brown & Sharpe design shown at *C*, Fig. 25. In this case, a draw-bolt is employed to hold the driving member in place. In another design, flats are formed on the back of a center or body, such as shown at *B*, to which the mill is keyed. This construction is used on milling machines made by Alfred Herbert, Ltd., Coventry, England. When the draw-bolt has been released, the milling cutter may be forced off the taper by inserting two screws, like the ones shown at *J*, and tightening them against the spindle face.

When the Brown & Sharpe design of spindle shown at *C* is to be used for driving an arbor, a suitable driving member is formed at the end of the taper. This driving member fits inside the clutch. An adapter is also made in which is incorporated the taper nose and clutch drive principle for use on a spindle having a threaded nose. In this case, the threaded nose is covered with a tapered sleeve, and a driver and draw-bolt are employed.

* * *

AUTOMATIC MILLING-CUTTER GUARD

Production rates have been materially increased in a hand-milling operation performed on brass castings in one of the shops of the General Electric Co., Schenectady, N. Y., by providing a guard for the gang of cutters. This guard makes it impossible for the operator to touch the cutters in reloading work; hence, reloading is accomplished more quickly, and it is not necessary to withdraw the work as far from the cutters for reloading as was formerly the case. Fig. 1 shows the guard closed as it is when the work is in the reloading position, while Fig. 2 shows the guard open at the bottom, with the cutters in position for an operation.

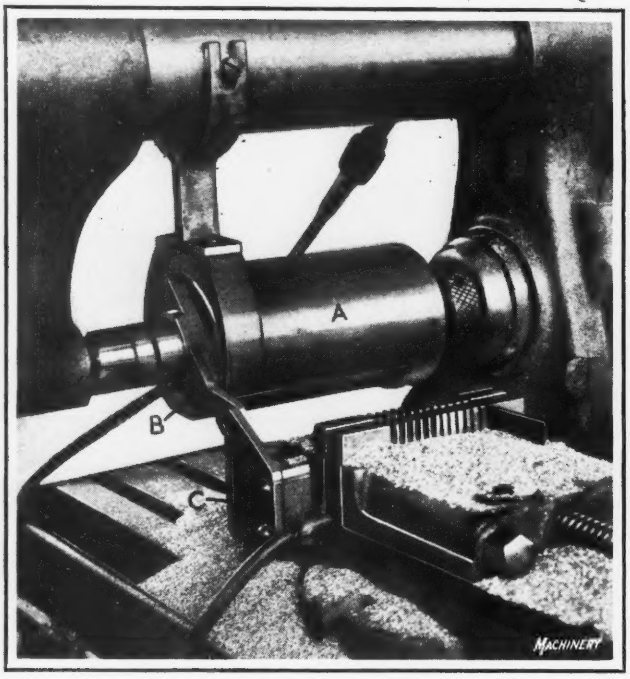


Fig. 1. Guard for Milling Cutters in Closed Position

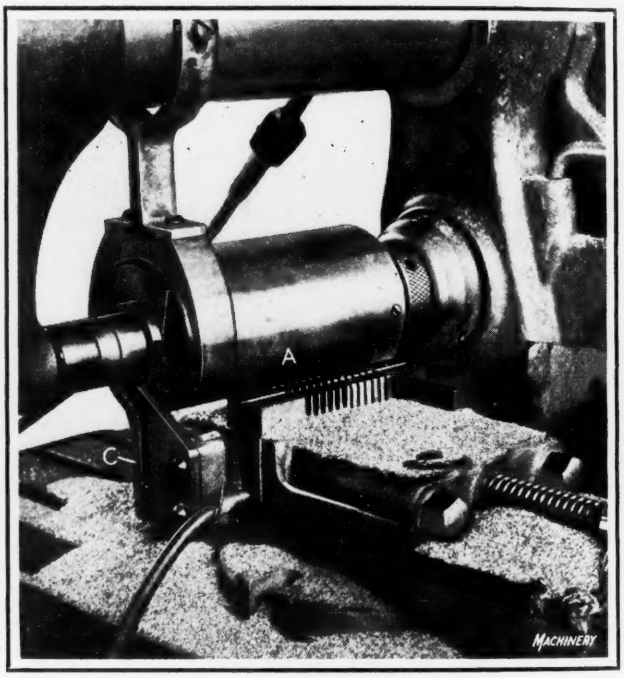


Fig. 2. Guard Open, Ready for an Operation

The guard consists essentially of a stationary circular housing *A* and a piece that slides within the stationary housing when actuated by lever *B*. A pin attached to this lever engages a slot in bracket *C*, which is mounted on the work-holding fixture. When the fixture is advanced to feed the work to the cutters, the pin of lever *B* follows downward along the slot in bracket *C* and slides the movable piece of the guard into the housing to expose the cutters. Conversely, when the work-holding fixture is withdrawn from the cutters, the guard is again closed as the pin of the lever rides up the slot of the bracket. Twelve slots are cut simultaneously in two brass pieces by the gang of cutters.

The Information in a Machinery Catalogue

By H. S. RIGGS, Lodge & Shipley Machine Tool Co., Cincinnati, Ohio

"PLEASE send me your catalogue."—Thousands of such requests are received daily by machinery builders. They are one of the early links in the chain that ends with the ultimate order. What information does a man expect to obtain when he sends for a machinery catalogue? Just what is it that he wants to find out? If a catalogue could be issued that would answer all the questions that might be asked relative to any one type of machine, thousands of dollars now paid to salesmen would be saved.

As mentioned, the catalogue is one of the early links in the chain of effort to sell a machine. To be effective, it must, however, be a "convincing" link. It must appeal to the prospective buyer in such a way that it will make him want more information about a particular machine. When a salesman calls on a man who has previously requested a catalogue, he will, as a rule, find him in a receptive mood, provided the catalogue has stimulated his interest.

Many machinery builders take too much for granted. Instead of appreciating that their catalogue is, in fact, a salesman, and an inexpensive one at that, they seem to think that anything will do for a catalogue. Poor illustrations, stereotyped phraseology, and poor printing characterize many catalogues describing machinery that itself is of first-class quality. The manufacturer should realize that the catalogue must be well and carefully dressed, the same as the salesman, if it is to command attention. There are a number of rules that may be laid down for good machinery catalogue work. To disregard them may save some of the advertising appropriation, but eventually some orders will be lost that might otherwise have been booked.

Quality of Catalogue is Important

A machinery catalogue, to command attention, should be printed on a high quality of paper. The photographs should be retouched by artists who know how—not by a scenic artist who places a high light here and there, but by a man who understands how to bring out those features in the photograph that will appeal to the mechanical engineer—to a man who carefully scrutinizes every detail of the picture that arouses his interest. The illustrations should be clear and sharp. Too much attention cannot be given to this item.

Care should be taken in selecting a good printer. The finished job should be pleasing to look at; and this means that each page must be carefully laid out and close attention paid to paragraphing, borders, and similar features.

Advantages of Loose-leaf Catalogues

Some manufacturers issue bound catalogues at regular intervals, while others produce loose-leaf catalogues which can be conveniently kept up to date—a most important point. When bound catalogues are used, it is rather difficult to keep them up to date, and if a large supply is printed, changes are often made in pen and ink, which does not improve the catalogue and does not increase its appeal.

When a loose-leaf catalogue is used, the sheets on which changes have been made can be reprinted at small expense, and the catalogue can be kept up to date continually. In addition to this, loose-leaf catalogues can be made up to suit the occasion. Some inquiries call for certain types of equipment only, and in such cases it is useless and wasteful to send information on the complete line of machinery built. The writer, therefore, endorses the loose-leaf form.

The Cover of a Catalogue Should be Attractive

Magazine publishers have learned that an attractive cover actually sells copies of the magazine. An attractive cover creates the first desire for the magazine. It may be thought that conditions are different in the case of catalogues. They are not consulted because of their appearance, but because of the benefit the prospective customer hopes to derive from the machinery he is planning to buy. This is very true, but at the same time an attractive cover arouses the interest of the prospective buyer and creates a favorable impression of the machinery illustrated and of the firm building it.

Recently a machine building firm reissued a booklet on one of its machines, taking greater pains with the new edition and binding it in a new and pleasing cover. The new booklet was advertised extensively in the trade papers, had a wide distribution, and brought in considerable additional business. Of course, it was not the cover and the catalogue alone that brought in this business, but it is quite certain that the attractive appearance of the booklet created a desire for more information about the machine, and hence, constituted the first step toward a sale.

The Introduction to a Machinery Catalogue

An introduction is frequently lacking in machine catalogues. There are a few questions that the prospective customer naturally asks, and a suitable introduction should be included to reply to these questions. For example, when was the business of the machine builder established? What is his factory like? How large a business is he doing? These are questions that are legitimate and ought to be answered.

The prospective customer wants to know something about the factory in which the machines he intends to buy are built. He would like to see a picture of it—he would like to know how large it is, expressed in square feet of space. He would like to know something about the equipment of

that factory. It is of great value to impress him with the idea that the machine builder is fully capable of manufacturing the machine he is endeavoring to sell and of making good after the machine has been sold. Nobody likes to own an orphan machine, and if the catalogue can create a feeling of confidence in the mind of the prospect, a great deal has been done toward consummating the sale.

Describing the Machine

A clear, reasonably large illustration of the machine to be described is a necessary thing in a successful catalogue. The clearer the picture and the better the details are brought out, the more favorable the impression created in the customer's mind. All specifications should be complete, and the description of the machine should be thorough. It should be so written that it is easily read and understood. The reader should not be expected to understand the action of the machine from a few disjointed statements that presuppose considerable previous knowledge of the subject. All the important data should be included in brief, concise sentences. Stereotyped phraseology should be avoided.

Single sheet circulars should be used to show important units and attachments for the machines that are illustrated and described. Good clear illustrations giving the names of the parts, whenever possible, help the prospect to visualize the design and construction as much as the description of the attachment itself.

Special Booklets

When the firm builds machines for special purposes, in addition to a regular line, it is well to include in the loose-leaf binder the information on these special machines, but by using the loose-leaf form, it is possible to leave out these special booklets from the regular catalogue, when it is known that the machines described would be of no interest to the prospective customer.

These special booklets should be complete in themselves, each having an attractive cover design. On the inside of the first page a birdseye view of the plant, together with information about the qualifications and the fitness of the manufacturer to furnish a particular type of machine, is included. Then follow, the same as in the case of the regular line of machines, careful descriptions, with illustrations, showing the various important parts or attachments. Finally illustrations are shown of the machines at work; whenever line drawings are required, they should be employed. Last come complete specifications. In short, the special booklet contains all the necessary information, the same as the bulletins relating to the regular line of machines, and the prospective customer should not have to refer to any other booklets or bulletins to obtain additional information on any one machine. By this arrangement, it is possible to send out special booklets by themselves, when requested, and also to furnish them as part of a complete catalogue in a loose-leaf binder.

To Give Information Should be Primary Aim of the Catalogue

The main requirement is that the machinery catalogue should be informative. It should give the man who asks for it complete and up-to-the-minute information. It should impress him by the manufacturer's ability to supply him with the quality and type of machine that he requires, and it should present clearly, distinctly, and in simple language all the information that he may require about the machine.

Last, but not least, it must be remembered that the catalogue is but a link in a chain of efforts to secure business. The finest and most complete catalogue in the world cannot bring results unless it is intelligently placed in the hands of possible buyers. The judicious use of direct mail advertising, of trade journal advertising, and of salesman effort, is what brings the inquiries that materialize into orders.

* * *

EQUIPMENT FOR STUDYING AERONAUTICS

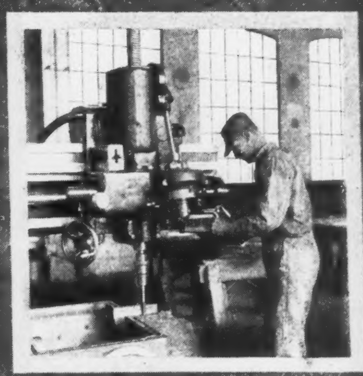
New York University is installing, in its new Daniel Guggenheim School of Aeronautics, a wind tunnel which, when completed, will represent the most up-to-date equipment in existence in this country for testing airplane models. Air velocities in the tunnel, it is estimated, will exceed 100 miles per hour. The college of engineering in that university already has available for aeronautical study a four-foot wind tunnel of the British National Physical Laboratory type in which experimentation is conducted up to air velocities of 60 miles per hour. Although primarily employed for purposes of instruction, this tunnel is available for tests and investigations in the study of airplanes and airships and in such allied fields as ventilation, the study of fans and windmills, and the measurement of wind pressure on structure.

The Daniel Guggenheim School of Aeronautics is housed in a new building erected on the campus of the university, and the new wind tunnel is housed in that building. This tunnel will be of the double-return type, having a diameter of 9 feet at the working section and an over-all length of 110 feet. It will be employed for the testing of airplane and airship models, for the study of aerodynamics or the science of air flow, and for problems in ventilating and heat transference. The tunnel will be electrically operated, all the electrical equipment being supplied by the General Electric Co. The wind-tunnel fan will be driven by a 250-horsepower direct-current motor, direct-connected to the fan shaft, and will revolve at 600 revolutions per minute.

* * *

According to a report just published by the Imperial Air Communications Sub-committee in England, the mileage flown in the world in commercial aviation in 1919 was 1,170,000, while in 1925 this had increased to 12,500,000. The engineering improvements are illustrated by a comparison of planes in 1919 which carried a paying load of 1250 pounds, with a horsepower of 700, and planes of 1925 which carry 4500 pounds of paying load, with a total horsepower of nearly 1200. The growth of traffic continued at an accelerated rate during 1926, when the traffic was 43 per cent greater during the first six months than during the corresponding period in 1925.

Letters on Practical Subjects



ARBOR FOR HOLDING BRASS CASTING

The accompanying illustration shows an arbor designed for a second operation on a brass casting. This casting, shown in dot-and-dash lines in the illustration, has previously been machined on the inside, a taper hole having been finished at the top and a straight hole bored at the bottom, as indicated. It is now necessary to finish some steps on the outside diameter. This work is done on a Warner & Swasey turret lathe, using the special arbor shown in the illustration.

The arbor is gripped by the shank *A* in a spring chuck in the lathe. The casting is inserted over the front of the arbor, nut *B* having previously been removed. The work strikes the plug *C* which fits the top taper hole in the casting, thus centering itself on this plug and on the ring *D* which fits the bottom hole. The nut *B* is now screwed on the arbor to bear against the work, forcing it against the plug *C*, which is a sliding fit on the arbor; the travel of plug *C* is limited by slot *E* and pin *F* which is a drive fit in plug *C* and a sliding fit in slot *E*.

A spring pin *G* is forced against pin *F* by the powerful spring *H*, so that when nut *B* forces the work against the sliding plug *C*, spring *H* is compressed until a lug on the work casting strikes the stop *J*. Consequently, the pressure of spring *H* is exerted in holding the work tight between nut *B* and plug *C*. This pressure is sufficient to hold the work during the cut, which is a comparatively light one, but if the work should slip, it is stopped by the stop *J* striking against the lug on the casting.

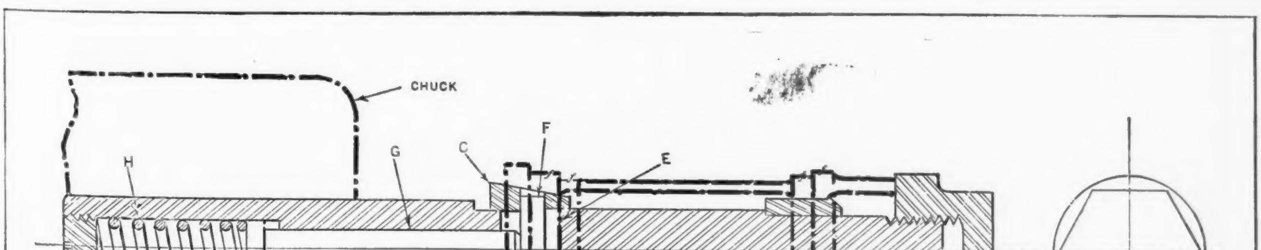
As the arbor overhangs a considerable amount from the chuck, it would be advisable to steady it with a plug or center mounted in the turret of the machine, this center fitting into a countersunk center hole that would be provided in nut *B*.

New York City B. J. STERN

INCREASING TOOL-ROOM EFFICIENCY

Many manufacturing concerns overlook their tool-rooms when endeavoring to increase the efficiency of their plants. If the tool-room is given the same attention as the other departments, substantial reductions in its overhead cost will result. Often tool-room work can be speeded up with very little effort. I will state, without fear of contradiction, that unnecessary finishing of unessential parts of the tool under construction, and unnecessary accuracy, are the sources of the greatest waste in time and money in tool-room work. These are the factors that should be given first attention.

Another source of considerable waste of time is found in the machining of tool parts. The machines in the average tool-room are run at a speed that is only about 50 per cent as high as it should be for efficient operation. If we take a walk through almost any tool-room, we will find that the shapers are being run at about one-half their efficient speed. Ten to one, the operator is letting the machine loaf along with a one-notch feed, in order to make the job last as long as possible. Then, again, the depth of cut being taken is probably about one-half as great as it should be.



Arbor for Holding a Brass Casting during a Second Operation

Walking over to the milling machines, we find the same conditions there, and in fact, the drill presses, reamers, planers, grinders, and various other machines are all run at speeds far below their efficient operating points. This may be due to the fact that the operators have not been trained to use their machines to the best advantage.

These conditions would not be tolerated for a moment in the production departments, as every machine there, must work at its full capacity in order to meet the keen competition that exists today. I believe that it is as important to obtain maximum returns on the money invested in toolroom equipment as on money spent for equipment in other departments.

Detroit, Mich. WILLIAM H. BLAKESLEY

INDEXING DRILL JIG WITH TILTING HOLDER

In Fig. 1 is shown a jig for drilling wooden knobs like the one shown in Fig. 2. The holes in these pieces are arranged in three circles. The holes in the inner circle are drilled vertically, that is, parallel with the axis. The holes in the next circle are drilled at an angle of 4 degrees 20 minutes with the center line, and the holes in the outer circle at an angle of 8 degrees 40 minutes with the center line. The parts also vary as to the number and size of the holes. In Fig. 2 specifications are given for two different parts *A* and *B*.

Referring to Fig. 1, the work is clamped in a round spring collet *A*, similar to the type used in a screw machine. This collet fits into and is operated by a round collar *B*, which is knurled on the outside. The work rests on a narrow ledge in the collet, and below the ledge is an ample pocket for chips and drill clearance. Three disks *M* are secured to the bottom of the collet, and revolve as a unit on the pivot screw *C*, fastened to block *D*.

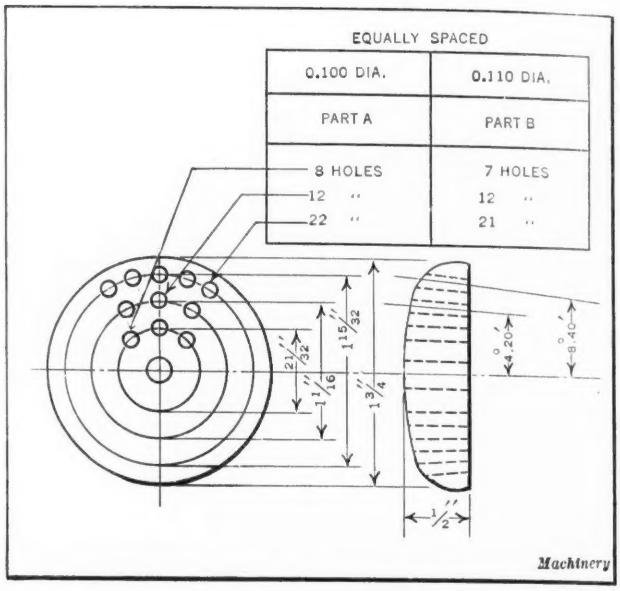


Fig. 2. Details of Drilled Part

The peripheries of the three disks have 90-degree notches in them, cut 1/16 inch deep. The number of the notches in the disks corresponds to the number of holes in the circles on the work, and the notches are used for indexing from one hole to another by engaging the indexing pin *E* mounted in base *F*. This index-pin is under spring tension, and is kept from turning by pin *G*, which fits in a slot milled in the base.

The support block *D* is mounted in a slot in the base on a pivot pin *H*. After the innermost circle of holes has been drilled, the block with the collet fastened on top is tilted down 4 degrees 20 minutes, and locked in position by disengaging pin *I* from hole *J* and engaging it in hole *L*. This brings the middle index disk directly opposite the index-pin *E*, and the work is then ready for drilling the second circle of holes at the required angle. The lower disk is engaged in a similar manner for drilling the outer circle of holes.

The two lower disks are larger in diameter than the upper one, and their peripheries and notches are cut at an angle of 4 degrees 20 minutes, and 8 degrees 40 minutes, respectively, so that when they are in their working positions, they are properly engaged by the index-pin. To disengage the index-pin while tilting the work into another position, the pin is moved out and given a quarter turn, so that the small cross-pin *G* is in contact with the outside of the base and prevents the index-pin from coming in contact with the disks. The drill bushings, as well as the index disks, are interchangeable to accommodate different parts.

The hinged lid *N* is thrown back for loading and unloading the jig, and is locked in position by the spring latch *O*. The work is clamped in place by a quick turn of the collar *B* over the collet. The thread on the collet is cut left-hand, so that the drill will not tend to loosen the clamping collet.

La Grange, Ill. BERNARD J. OLIVER

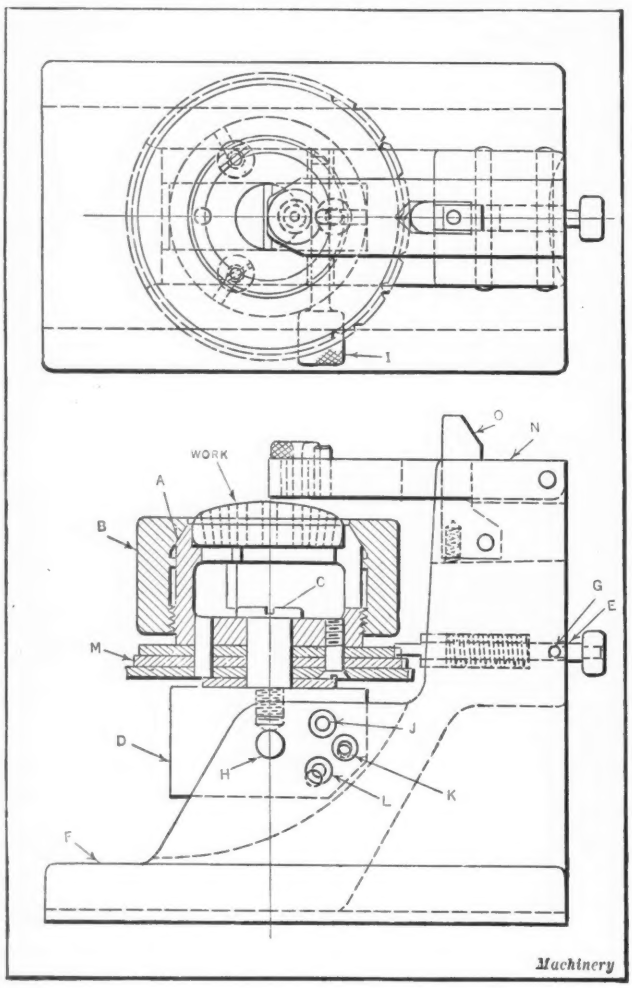
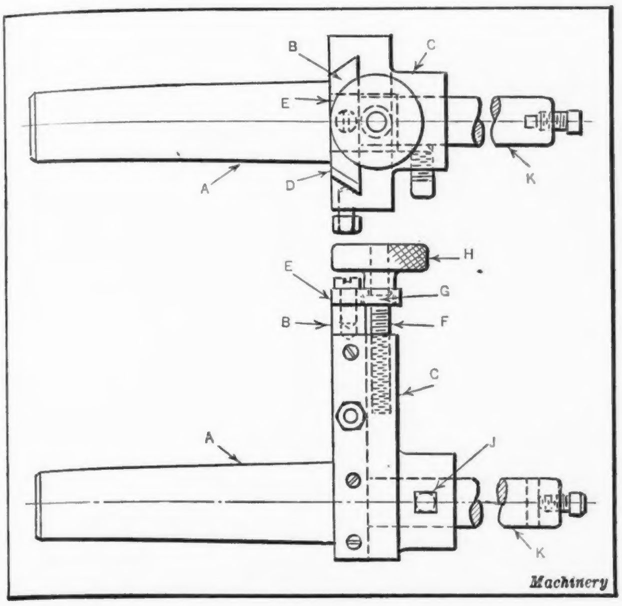


Fig. 1. Jig for Drilling Part Shown in Fig. 2



Adjustable Offset Boring Tool (One-third Actual Size)

OFFSET BORING TOOL

An offset adjustable boring-bar is a convenient tool to have in the shop. By its use boring jobs that are too large to swing in the lathe can often be readily handled in a milling machine or even in a drill press. An example of the kind of work for which a tool of this kind is adapted is the boring of the crankpin end of a gasoline engine connecting-rod after it has been rebabbitted.

The boring tool consists of the shank *A* having a right-angle extension member *B*. The edges of member *B* are beveled to fit the dovetailed slot in the tool-block *C*. A gib *D*, backed up by set-screws, provides means for making adjustments between the tool-block and member *B*. A plate *E* attached to the top of member *B* serves as a bearing for screw *F*, which is screwed into a tapped hole in the tool-block *C*. Screw *F* has a collar *G* which is let into a recess in plate *E* and takes the thrust of the screw. The knob *H* acts as a collar to take the screw thrust in the other direction.

The set-screw *J* in the tool-block *C* holds the boring-bar *K* in place. The boring-bars are provided with set-screws in both ends and sides for holding the tool bits. In making the tool, care is taken to so arrange the members that when the bar is in line with the shank, it will run concentric, as this is of great assistance in locating the tool in the proper relationship to the work. If it is desired to lock the tool-block when boring, one or more of the gib screws should be provided with a head to facilitate tightening with a wrench. The gib screws should have a fine thread, and be a snug fit in the tapped holes in the tool-block *C*, in order to prevent them from shaking loose. Instead of knurling the knob *H*, it can be graduated and a pointer attached to member *B*. The entire tool is made of steel, the shank being part of a broken gasoline engine crank.

Algona, Iowa — George Wilson

PRODUCTION MILLING ON A DRILL PRESS

Originally, the gear-case shown by the dot-and-dash lines in the plan view of Fig. 1 was machined on the inner faces *W* of the four bosses, by back-facing. This process, however, was not satisfactory, as only one face could be machined at a time, and hence the labor cost was rather high. It was also difficult to maintain the required accuracy.

As the production appeared to warrant the expense, it was decided to build some sort of milling attachment for a drilling machine, by means of which all the faces could be machined simultaneously. The construction of the attachment was not a simple problem, owing to the small space available for the driving gears, the housing, and the cutters. In the final analysis of the problem, it became a question of designing the simplest mechanism possible and proportioning the parts to give the greatest strength and longest life to the moving parts. This, of course, should be a prime requisite in all machine designs, but in this case it was absolutely necessary. The design illustrated has accomplished all that was expected of it, and has been in operation for some time. It effected a marked saving in time and labor, and greatly increased production at an upkeep cost that has been practically negligible compared to the saving that was made possible.

The fixture is clamped to the table of the drill press by two hold-down bolts, after being properly located with reference to the spindle by the guide posts *A*. The milling head *Y* is clamped to the free spindle sleeve by cap-screw *B* in the body of the

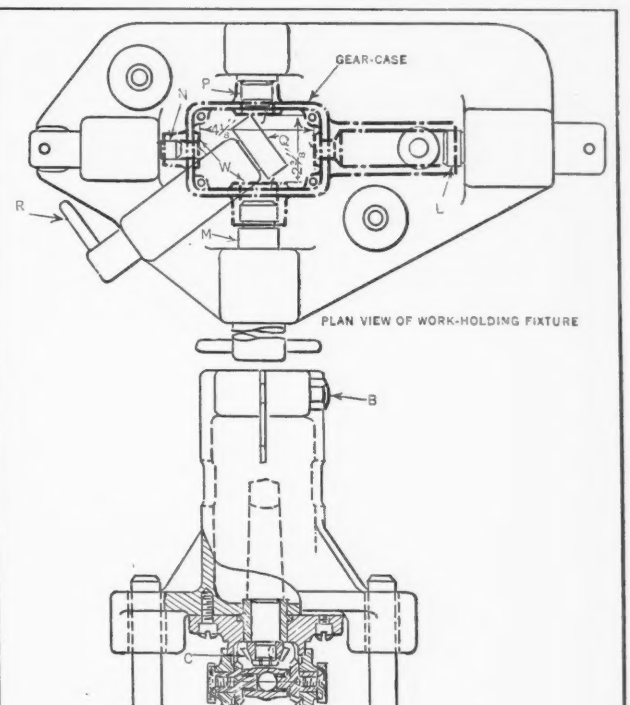


Fig. 1. Work-holding Fixture and Milling Head Used on Drill Press

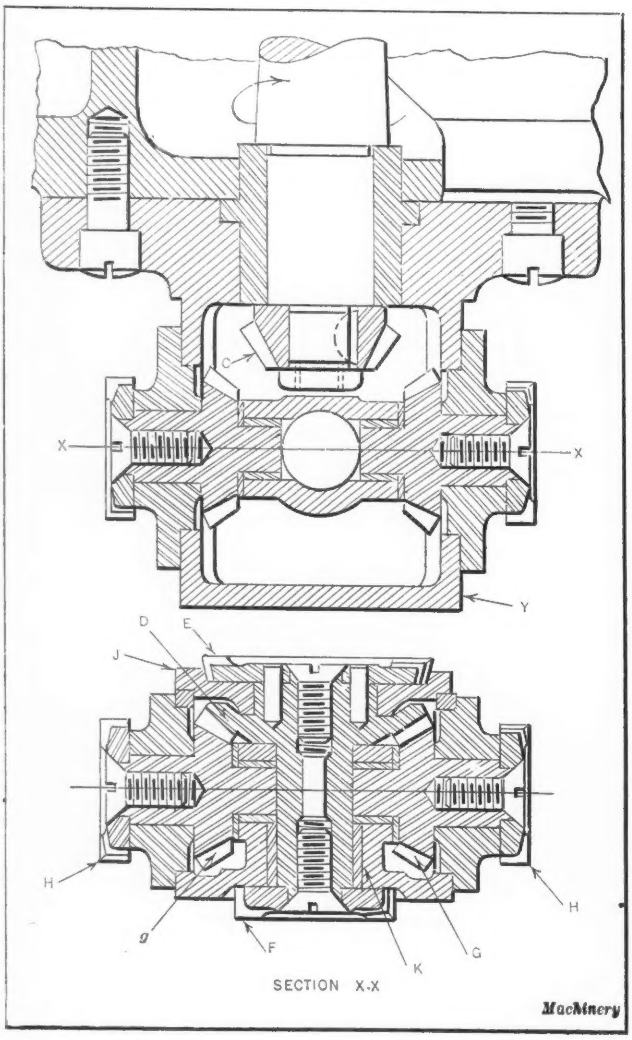


Fig. 2. Assembly Views of Milling Head

head, and the taper shank is entered and pushed home ready to drive.

The taper shank drives the bevel pinion *C*, which, in turn, drives the bevel gear *D*, Fig. 2. It will be noted that bevel pinion *C*, revolving in a clockwise direction, revolves gear *D* in an anti-clockwise direction. With the cutter *E* made to cut right-hand, the cutter *F* mounted on the opposite end of the same gear will necessarily cut left-hand. Bevel gear *D*, driving cutters *E* and *F*, also drives bevel gears *G* and *g* to which, in turn, are secured cutters *H*. Cutters *H* are both left-hand and of the same size. Gears *G* and *g*, being engaged with gear *D* at points diametrically opposite each other, revolve in opposite directions, so that cutters *H*, which are fastened to *G* and *g* and driven by them, revolve in the same direction. Consequently, cutters *H* are both made left-hand.

The gears and pinions used in the attachment are of the best heat-treated steels, ground and polished or lapped to give as accurate fits as possible. The accurate, smooth-running fits give the machine longer life and low upkeep cost. The gears are, of course, kept well supplied with oil. Gear *D* is a running fit in the cover *J* and in bushing *K*. Cutters *E* and *F* are held to as close a running fit as possible on the shoulders on gear *D*. The same construction is also employed for gears *G* and *g* and cutters *H*. Three of the cutters are mounted on squares on the hubs of the gears and held in place by flat-head set-screws sunk beneath the cutting faces. The fourth cutter *E* is driven by two dowels, and held in place in the same manner as the other cutters.

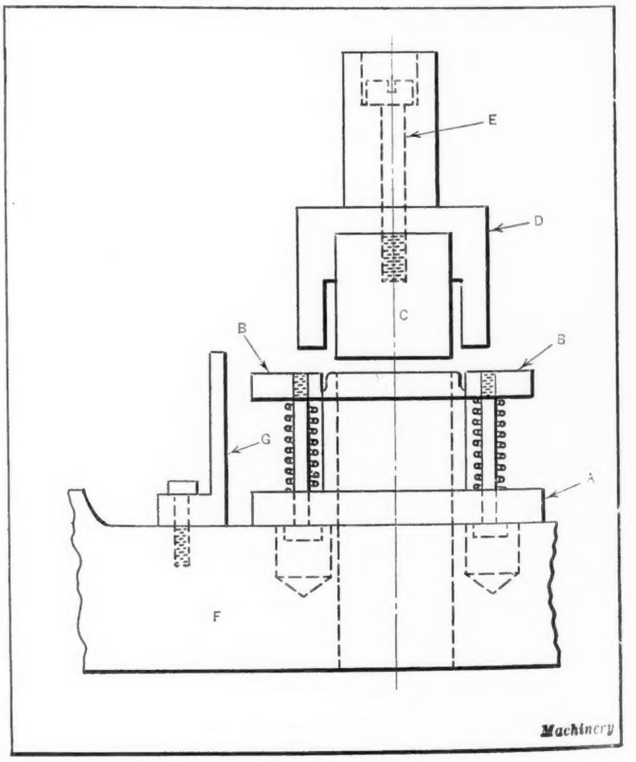
Three slip plugs *L*, *M*, and *N*, Fig. 1, are provided for locating the work. These plugs are withdrawn in order to permit the work to be loaded into the fixture. The plugs are limited in their travel by pins *O*. The pieces are pushed down on the fixed plug *P*, after which plugs *L*, *M*, and *N* are pushed into place. The locating plugs are made to fit the holes in the work as closely as the manufacturing limits will permit. The clamping cam *Q* is tightened by operating handle *R*. The guide posts *A* are made of sufficient length to prevent them from coming out of the holes in the body of the milling fixture under ordinary operating conditions.

Syracuse, N. Y. E. P. STOUTENGER

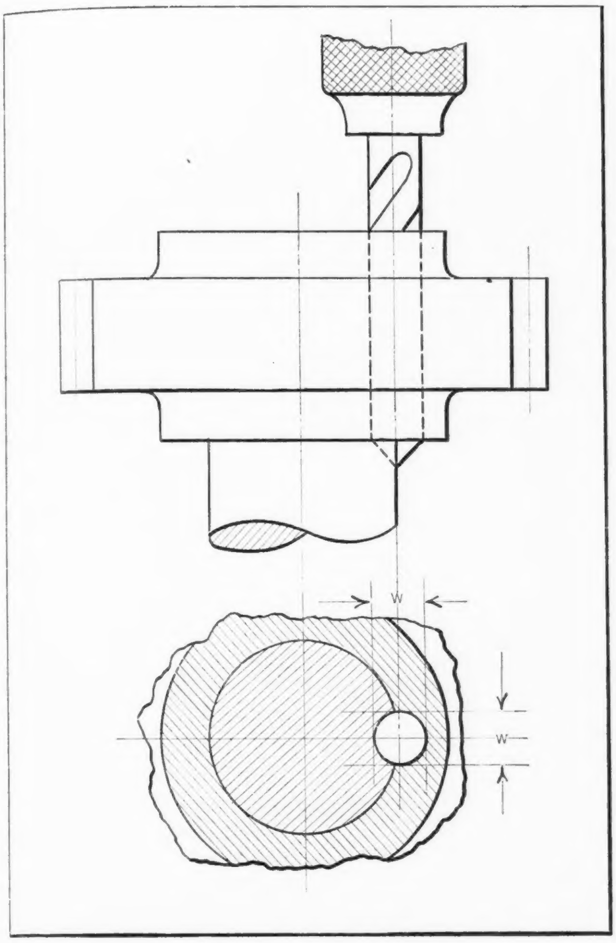
DIE FOR PIERCING AND FLANGING HOLES

The die shown in the accompanying illustration was built to pierce an oval hole in the body of an aluminum tea-kettle and draw a flange around the edge of the hole. The spout is welded to the body over the flanged hole. The flange, which is about 1/8 inch high and fits inside the spout, serves to locate the spout on the body shell. The die *A* is of hardened tool steel and is secured to the horn *F* of the press by dowels and machine screws. The stripper plate *B* is a sliding fit over the die, and is held in place by four screws. The springs placed over these screws serve to push the plate *B* upward after the piercing and flanging operation, and thus strip the work from the die member. The piercing punch *C* is held in the forming punch *D* by the screw *E*. The scrap punched out by the central punch *C* passes through the die *A* and the horn *F*. Gage *G* serves to locate the shell on the die.

Navarre, Ohio GEORGE R. CASTER



Die for Piercing and Flanging Oval Hole



Method of Drilling out Metal for Keyway

DRILLING OUT METAL FOR KEYWAYS IN ASSEMBLED PARTS

The method shown in the accompanying illustration will be found useful for quick repair work in laying out and cutting keyways, where machine tools adapted for the work are not available. When a pulley and shaft or a gear and shaft are to be keyed, the usual practice is to mark the keyseat on the end of the work, then separate the parts and cut the keyway in the shaft and in the gear or pulley. Often the keyways are cut with a hand chisel.

With the method shown in the illustration, the workman selects a drill corresponding in diameter to the given width *W* of the key, and drills a hole as indicated, the point of the drill being centered on the joint. The hole is drilled to the full depth of the gear or pulley hub. A small amount of metal remains in the corners of the keyway, which can be removed with a hand chisel. One of the advantages of this method is that the keyways of the two parts match or line up properly, regardless of any departure of the drill from the true path parallel to the axis of the shaft. This method can only be used, of course, when the gear or pulley is assembled at the end of the shaft.

Washington, D. C. — G. A. LUERS

LAYING OUT POSITIVE RETURN DISK CAMS

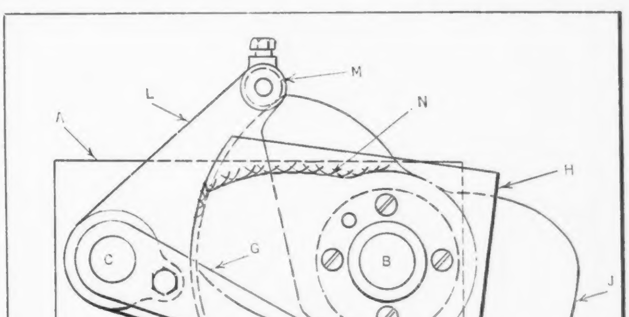
In the design of positive return disk cams of the type in which both forward and return cams are mounted on one shaft, and the cam-lever, carrying two rollers, is in constant engagement with both cams, only one cam, usually the working or forward one, can be dimensioned accurately.

Dimensions for the rise and drop lobes of the return cam cannot be calculated, and while it is possible to make an accurate lay-out of these lobes, the dimensions obtained by scaling the lay-out will be approximate at best and difficult for the machinist to follow. The cam milled to these dimensions is bound to be loose in some places and tight in others, and will require patching or the use of larger cam rollers than originally intended. In this case, the high places must be filed down to the required profile. This method is rather slow and unsatisfactory where accuracy is required.

The following method of producing accurate positive return disk cams was used successfully by the writer, and will doubtless prove of value to readers of MACHINERY. This method is applicable when an accurate templet is required for use in a special cam milling machine for producing duplicate cams. Several different sets of cams are required for the same machine to meet the requirements of different jobs. In general, the method consists of marking the exact outline of the return cam on the cam blank in a simple fixture, and removing the excess stock by milling and filing to the marked outline.

The fixture consists of a cast-iron or machine steel plate *A* of suitable thickness, and two studs *B* and *C* pressed into plate *A*. The distance between the centers of the studs in the fixture is the same as the center distance between the camshaft and the cam-lever pivot shaft in the machine for which the cams are made. The diameters of the rods are the same as the diameters of the camshaft and the cam-lever pivot shaft, respectively.

The collars *D* and *E*, which are loose on studs *B* and *C*, are used for raising the cam and cam-lever *L* above the fixture base. These collars also serve to bring the cam and the cam-lever into proper alignment. The cam-lever *L* is part of the ma-



Device for Use in Scribing Outline of Return Cam

chine on which the cams are used. A suitable boss and tapped hole should be provided on lever *L* for fastening bracket *G*. A scribing disk *F*, of the same diameter as the cam roller *M*, is fastened on bracket *G*. In locating bracket *G* on lever *L*, care should be taken to bring the center of the scribing disk in line with the cam-roller stud on lever *L*.

The finished forward or working cam *J* and the return cam blank *H* are secured to the hub *K*, being fastened together by means of dowels and screws. The upper surface of the cam blank *H* is covered with blue vitriol, in order to permit the scribed lines to show more clearly. The assembled unit is placed on the stud *B* in the fixture. Lever *L*, with cam roller *M* fitted on one arm and the scribing disk fastened on the other arm, is put on the stud *C*, as shown in the illustration. With the cam roller pressed against the finished cam *J*, and the cam unit held in such a way as to prevent its turning on the rod, a short line is scribed on the cam blank, using disk *F* as a guide for the scriber. The cam is then turned a little, and another line scribed. This operation is repeated until the outline of the return cam is complete.

Then the cam blank is removed from the hub and machined to the scribed outline. The circular portions or dwells of the cam are machined by milling to the line. The irregular lobes of the cam are milled within 1/64 inch of the line, and finished by hand or machine filing. After removing bracket *G* and fastening another cam roller in place, the return cam, which has previously been casehardened, is assembled, with the hub *K*, to the forward cam *J* and the lever *L*. These members are then ready to be assembled on the machine.

Chicago, Ill. A. J. PRUSZYNSKI

GUIDE BAR CLAMPS

Guide bar clamps for holding locomotive guide bars on a face grinder while truing the guiding surface are illustrated in Fig. 1. Fig. 2 shows a detailed view of one of these clamps. The base *A* is bolted to the table of the grinder, each clamp being held in alignment by a tongue on the bottom of base *A* that engages one of the table T-slots. Section *B* is hinged to *A* at *C*, and its rear end is

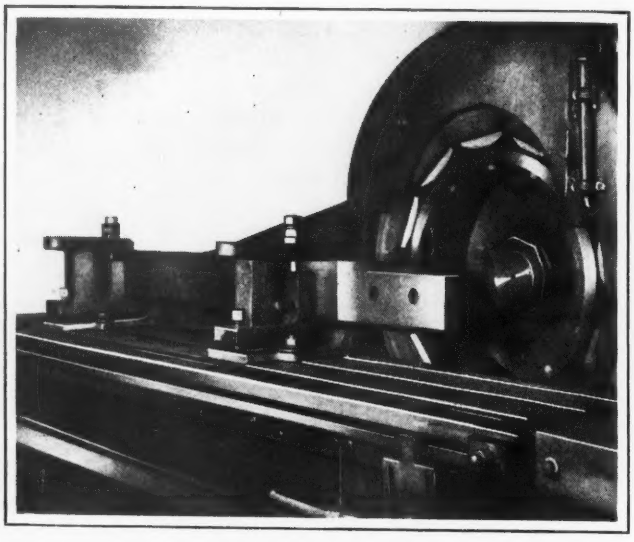


Fig. 1. Guide Bar Clamps which can Readily be Adjusted for Locating Work in Position for Grinding

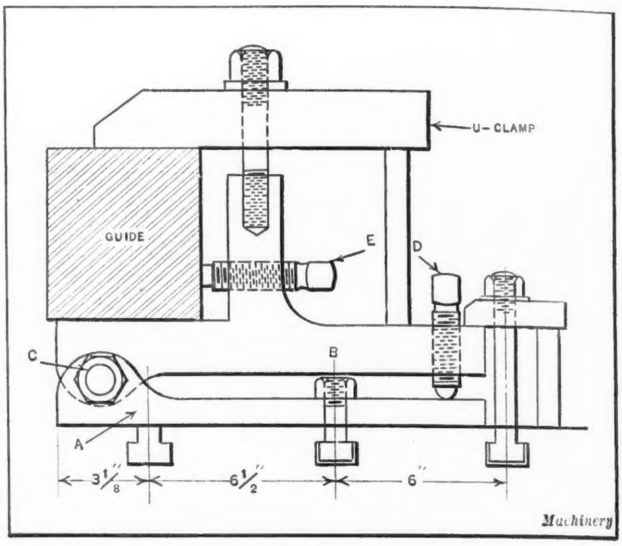


Fig. 2. Side View of Guide Bar Clamp, Showing Means of Adjustment

supported by a 1-inch adjusting screw *D*. The method of clamping the guide to part *B* is clearly illustrated. It will also be noted that each clamp has a backing screw *E* which bears against the guide. With this design of clamp, the guide may be adjusted quickly for locating the face to be ground in the right position, merely by raising or lowering hinged part *B*, with adjusting screw *D*.

Huntington, W. Va. E. A. MURRAY

INDEXING ON A DRILL PRESS

In the article "Indexing on the Drill Press," on page 278 of December MACHINERY, it is suggested that concentric circles be scribed on the face of the drilling machine table. This seems to be rather an unusual suggestion in view of the fact that nearly all drilling machine tables that the writer has seen have concentric circles scribed on their faces. The writer also fails to see what would be gained by graduating the edge of the table as described. As a matter of fact, some drilling machine makers at one time provided this means for indexing, but discontinued the practice, as there was very little demand for machines so equipped.

In regard to drilling holes around a circle, if only one piece is to be drilled, the usual method of laying off the holes would be cheaper and probably just as accurate as indexing with the graduated drilling machine table. Even with the use of an indexing head, the spacing between any two holes would vary, due to play in the drill spindle and variations in the grinding of the drill. To obtain a fairly high degree of accuracy would also require a drilling machine table having a very true surface and a spindle in accurate alignment with the drilling machine spindle.

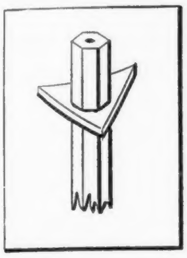
A high degree of accuracy is not generally required in drilling holes on a circle in such products as flanges. For work of this kind, it is a simple matter to lay out and drill one piece, and then use this as a jig for drilling the remaining pieces. The writer believes that this method would be much quicker and cheaper than the practice of using a graduated drilling machine table.

Groton, Conn. ARTHUR SILVESTER

Shop and Drafting-room Kinks

SAVING POINTS ON DRAWING PENCILS

Ever since the first draftsman put pencil to paper, the pencil has been a source of trouble by allowing itself to be acted upon by gravity and other causes and arriving on the floor with its business end first. Hexagon pencils give a little less trouble than round pencils. Various means have been devised for overcoming this difficulty.



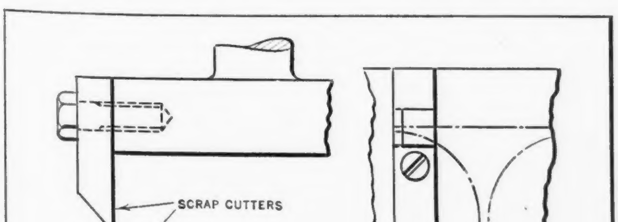
Method of Saving Pencil Points

After trying a number of methods, the writer has found the greatest satisfaction in a small triangular piece of an automobile inner tube, perforated so that it can be slipped over the tip of the pencil, as shown in the accompanying illustration. If the hole is made small, the rubber pulls into a conical shape with the points of the triangle projecting, and thus forms an excellent and inconspicuous non-rolling, non-skid device, without clumsiness or noticeable weight. If the pencil should be knocked from the table, the weight of the rubber will cause the unsharpened end to strike the floor first, so that in most cases, the point will not be broken. W. S. B.

SCRAP CUTTERS FOR BLANKING DIE

A decided saving in time and labor has resulted from installing scrap cutters, such as shown in the accompanying illustration, on the blanking and piercing dies used in our plant. Before these cutters were used, an extra man was employed to stack the blank strips after they were fed through the press. The scrap cutters eliminate the extra or non-productive labor and also facilitate the handling of the scrap, which drops into a box placed at the rear of the press as fast as it is cut up into small pieces by the scrap cutters. These cutters are so located that they cut off the scrap stock at the narrowest section.

Philadelphia, Pa. SAM KAUFMAN

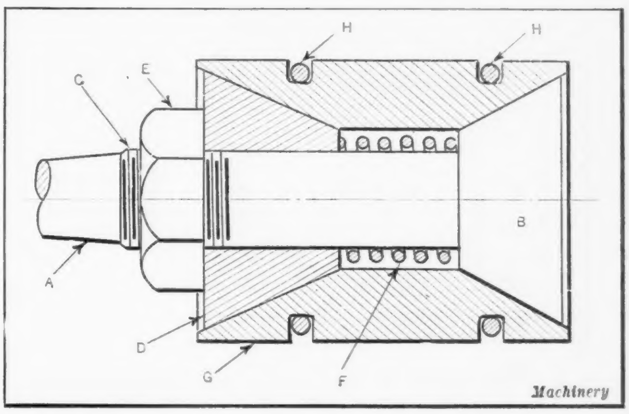


Die Equipped with Scrap Stock Cutters

EXPANDING MANDREL FOR THIN WORK

One of the problems in turning thin brass cylinder liners for plunger pumps is to provide a mandrel for holding the work while turning the outside to a close force fit. A mandrel used on a lathe for this purpose which permits the work to be chucked accurately and removed quickly, is shown in the accompanying illustration.

The shank *A* of the mandrel fits the tapered hole in the lathe spindle. The body of the mandrel has a cone end *B* and a thread at *C*. The cone *D* is a sliding fit on the mandrel, and is held in contact with the nut *E* by the spring *F*. When nut *E* is tightened, cone *D* is forced in, causing the three pieces forming the sleeve *G* to expand or move outward so that they obtain a good grip on the work.



Expanding Mandrel for Holding Thin Cylindrical Work

The sleeve members *G* are held in place by two spring-wire rings *H*, fitted in grooves cut in the sleeve members. The stiff spring *F* serves to separate cones *D* and *B* when nut *E* is loosened, so that the sleeve segments will contract and permit the work to be removed. Several sizes of work may be held on the mandrel by providing sets of sleeves *G* of different diameters.

Washington, D. C. G. A. LUERS

* * *

In *Grits and Grinds*, published by the Norton Co., Charles H. Norton relates some of his early experiences in the building of grinding machines. One of the first machines built had been sold to a Vermont plant, and it was found that the grinding machine produced twice as much work as had been produced in years by the lathe man who had turned this work in the past. After the grinding machine was placed in operation, however, the lathe operator apparently concluded that this machine would deprive him of a job unless he braced up and showed what he could do. The result was that he soon produced over three times as much as he had ever produced before the introduction of the grinding machine. Hence, the improved grinding method for producing cylindrical work aided production in this shop in two ways.

Questions and Answers

WELDING CRACKED CYLINDERS

A. S. C.—Is there any method by which automobile cylinders that are cracked as the result of freezing can be welded without preheating? We have tried several methods, including brazing with bronze and welding with nickel rod. An alternating-current electric arc welder has also been used, but with little success.

This question is referred to any readers of MACHINERY who may have had experience with this class of work.

END THRUST FROM HELICAL GEARING

A. H.—On a certain type of machine, the end thrust from helical gearing is to be utilized for holding, against its joint, the cover of a container which rotates in unison with the cover. The cover is attached to the shaft on which the driven gear is mounted, and the driven gear meshes with a driver on a parallel shaft, the gears being the single helical or "twisted spur gears." The pressure resulting from the end thrust must be sufficient to seal the joint and to prevent leakage of the liquid in the vessel while the machine is in operation. The load transmitted to the driven gear is equivalent to 7 horsepower, the pitch line velocity is 200 feet per minute, and the inclination of the teeth relative to the axis is 15 degrees. Approximately what end thrust would be obtained under these conditions?

A.—In order to determine the end thrust, first calculate the tangential load on the gear teeth. Since in this case the amount of power to be transmitted is 7 horsepower and the velocity 200 feet per minute, the tangential load will equal $33,000 \times 7 \div 200 = 1155$ pounds. The axial or end thrust may now be determined approximately by multiplying the tangential load by the tangent of the tooth angle. Thus, in this instance, the thrust $= 1155 \times \tan 15$ degrees $=$ about 310 pounds. The end thrust obtained by this calculation will be somewhat greater than the actual end thrust, because frictional losses in the shaft bearings, etc., have not been taken into account.

ASSIGNMENT OF PATENTS

N. Q.—Can an employer apply for and receive a patent issued in his own name, when, in fact, one of his employes is the real inventor? Also please give me information regarding who may legally assign a patent and under what circumstances.

Answered by Leo T. Parker, Attorney at Law
Cincinnati, Ohio

A.—Legally a patent may be "applied for" only in the name of the inventor. In other words, simply because an employer has the legal right, by contract or otherwise, to obtain title to the inventions of an employe is no reason why the employer may apply for and secure the patent in his own name. The law distinctly specifies that only the inventor may do this. While the employer may apply for and receive a patent for an article actually invented by another person, so long as the Patent Office officials are not informed of the true relation, if the employer does so, the patent is void and of no effect. Moreover, when an application for a patent is filed, the inventor must make oath that he believes himself to be the inventor of the thing to be patented.

As to who may legally assign a patent, the answer is that only the real and true inventor may make a valid assignment. The assignment may be made when the application is filed, or at any time before or after the patent is issued. Also, it is important to know that the assignment of a patent must be in writing and recorded in the Patent Office within three months after the date of the assignment. (219 F. 213) If it is not recorded, a later creditor or purchaser may cause the original assignee trouble; but (as stated in 32 Fed. 783) there is no regulation for recording merely an agreement to make a future assignment of a patent not yet issued.

Sometimes an employer enters into a contract with an employe, by which the employe agrees to assign all inventions perfected during the employment. The Court held that even though the contract contains no express provision that the employe will sign a written assignment, the law will imply such an agreement. (80 N. Y. S. 1083)

In another case, a patent was applied for by an ex-employe after the termination of the employment, and it was disclosed that a contract had existed by which the employe agreed to assign his inventions in favor of the employer. In this case (138 F. 924) the Court held that the employer was entitled to an assignment of the patent, if it could be proved that the employe perfected the invention during his employment.

OVERHEAD COSTS

I. V.—What costs are generally included in the general term "overhead?"

A.—The term "overhead" or "overhead expense" generally includes all items of cost that cannot be directly charged as wages of productive labor or as cost for materials used in actual manufacturing. Such expenses include such items as salaries of company officials and supervision in the shop, general office expense, office supplies, advertising, selling expense, traveling expense, losses from bad debts, power, light, heat, insurance, taxes, depreciation, general repairs, and shop supplies, shipping expense, storekeeping, purchasing, accounting, inspection, safety work, engineering and drafting-room expense, and research work. In different plants, there would evidently be different items that would have to be charged to overhead, but generally speaking, it includes costs that cannot be charged to productive labor and the cost of materials.

New Machinery and Tools

The Complete Monthly Record of New Metal-working Machinery

LANDIS HYDRAULIC CRANKPIN GRINDING MACHINE

With the development of a hydraulic machine by the Landis Tool Co., Waynesboro, Pa., a new method of grinding the pins of automotive crankshafts has been obtained. The claims made for the new method are a large saving in equipment, reduced labor and operating costs, and a large increase in production. All the pins of a crankshaft are ground in one machine, which reduces the handling of work and storage space for partly finished crankshafts, in addition to providing several other advantages.

Among the features of the machine are hydraulically operated clamps on the work-carrying fixtures; special indexing fixtures for obtaining proper angular relation between the pins; a hydraulic power feed to the wheel-head for both the in feed and the grinding feed; a rotary hydraulic motor for quickly moving the work carriage to bring the various pins into the grinding position; a device for accurately spacing the various pins relative to a fixed locating point on the shaft; and a special hydraulically operated work-rest which is so located that it is always in front of the wheel on the pin being ground. A larger diameter grinding wheel is provided than on previous machines, to obtain longer life and reduce the frequency of dressings.

The work-heads are driven in unison, power being supplied by a two-horsepower motor which drives through worm-gearing. The headstock spindles are driven by silent chains, provision being made for taking up lost motion and for adjusting the alignment between the spindles. The crank-carrying fixtures are integral with the spindles, and are equipped with hydraulic work clamps on which the full pressure is maintained at all times. Variations in the throw of different crankshafts are taken care of by interchangeable clamping blocks. The hydraulic pressure applied to the clamps comes through the headstock spindles and is controlled by means of a valve that is located within easy reach of the operator at the front of the machine. A safety device prevents rotation of the heads until the crankshaft is securely clamped.

The indexing fixture locates the shaft either from the holes in the flywheel flange or from locating lugs on the cheek of the crank. The indexing fixture consists of a plate provided with plunger holes for obtaining the proper angular relation. In order to index the crankshaft, it is only necessary to release the hydraulic clamps and rotate the shaft in the carrying fixtures until the pins to be ground are on the center of rotation. The clamps are then closed and the grinding is started.

The spacing device consists of a rigid bar located beneath the work-table. Lugs are fastened on this bar in the proper location for the various pins on the shaft. A solid stop on the under side of the work-table comes against the lugs on the bar, thus positioning the pins exactly with reference to a previously determined locating point. A lever on the front of the machine controls the bar and is operated to bring the proper lugs into position to engage the positive stop on the work-table.

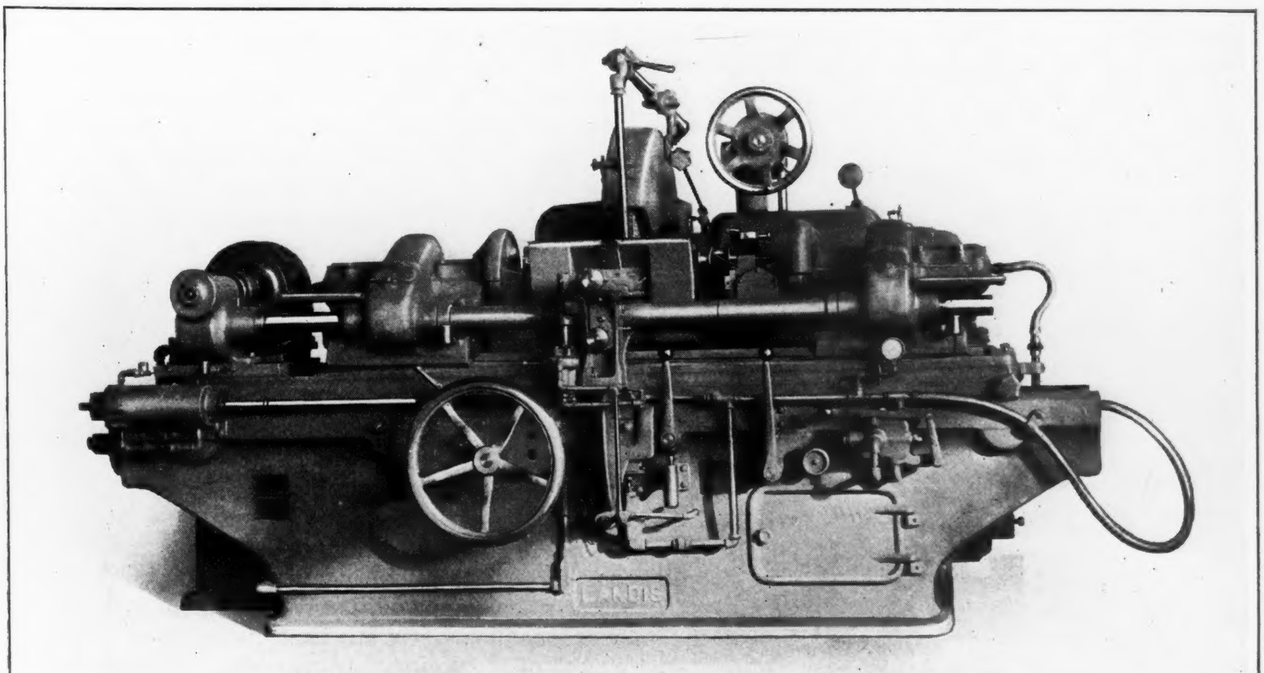


Fig. 1. Landis Hydraulic Machine which Grinds All the Pins of a Crankshaft in One Operation

The stationary hydraulic work-rest, which is a particularly interesting feature, is rigidly attached to the bed of the machine, so that it is directly in front of the grinding wheel and always in position to support the pin being ground. The work-rest consists of two parts—the base, which is clamped rigidly to the machine bed, and the movable part, which is operated hydraulically to bring the work-shoes into position. The movable part is held against fixed stops by hydraulic pressure.

Final adjustment of the work-shoes is made by means of hand adjusting screws. In this way, the actual amount of pressure applied to the pin and the actual sizing are controlled by the hand of the operator. Stops are provided on the hand adjusting screws, so that conditions can be duplicated on every pin being ground. The movable part of the rest is drawn back to clear the shaft when moving from one pin to another. The action is simple and is controlled by a valve at the side of the stationary part. When this valve is in one position, the rest is moved to the extreme rear position, giving sufficient clearance for positioning, removing, or putting the shaft in place. When the valve is in the reverse position, the movable part is in the extreme forward location with the work-shoes against the pin being ground.

The rotary hydraulic motor which moves the work carriage to the pins to be ground is controlled by a lever which is always in the neutral position, except when the carriage is being moved. A safety device prevents the hydraulic pressure from being applied to the motor while the work is rotating, thus eliminating all possibility of an accident caused by a careless operator. The application of hydraulic power to the carriage, together with the positive spacing device previously mentioned, gives a quick and accurate method of locating the work in relation to the grinding wheel.

The rapid hydraulic power in feed provides a quick and easy method of moving the grinding wheel back out of the way when moving to the next pin and when removing or putting in the crankshaft. Control of this rapid feed movement is afforded through a lever located close to the feed-up handwheel. When this lever is pushed away from the operator, the wheel-head moves away from the work at high speed until it reaches the back position, where it automatically comes to a stop. When the lever is pulled toward the operator, the wheel-head moves in at high speed until the wheel comes in contact with the work. The wheel-head then automatically slows down to the predetermined grinding feed and continues to move in at this slow feed until it comes against a positive sizing stop.

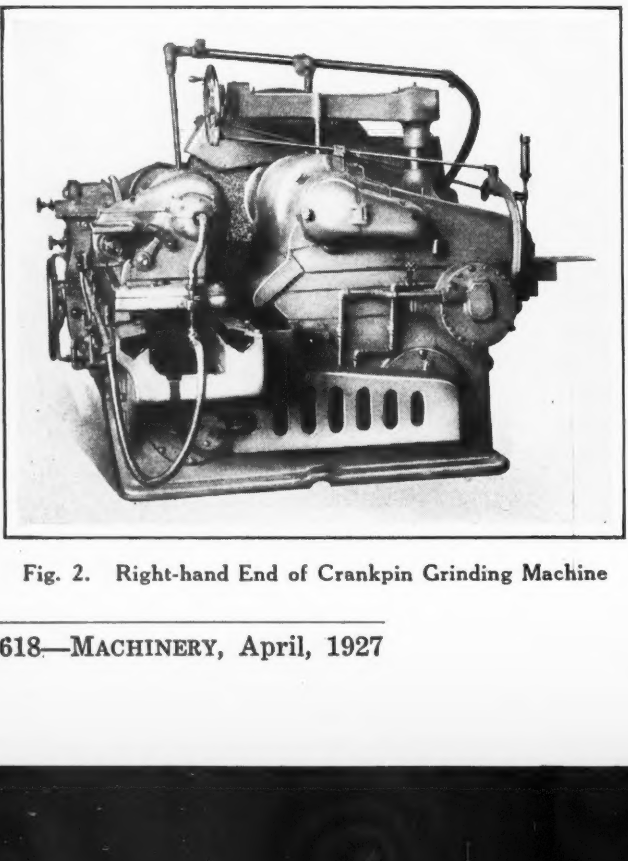


Fig. 2. Right-hand End of Crankpin Grinding Machine

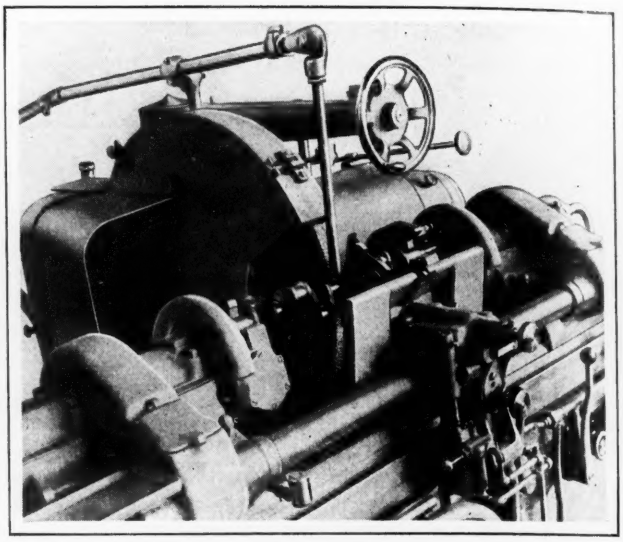


Fig. 3. View of Hydraulic Rest in Forward Position and Arnold Gage on Pin being Ground

The grinding feed can be easily varied to meet any condition, and the positive stop can be changed to take care of any variation in the diameter of the wheel due to wear or dressing. Also, the point where the wheel-head slows down to the proper grinding feed can be varied to meet conditions. A hand feed similar to that employed on previous Landis grinding machines is also provided, and may be used independently of the hydraulic power feed.

The wheel-head is rigidly supported on the bed of the machine. Its spindle is made of alloy steel, is heat-treated and ground, and runs in adjustable cap bearings which are automatically lubricated by oil under pressure. Pressure lubrication is also provided on the thrust bearings.

This hydraulic machine is built in two sizes, 16- by 32-inch and 16- by 42-inch. In addition to the 2-horsepower motor used for the work drive, a 20- or 25-horsepower motor, depending upon the character of the work, is used for the grinding wheel drive. The wheel may also be driven from a lineshaft through an auxiliary drive bracket, if desired, but the work is always driven by a motor equipped with an automatic control which is operated through the start-and-stop lever of the machine.

BROWN & SHARPE WORM-THREAD GRINDING MACHINE

Worm threads—both hardened and unhardened —may be ground on the No. 30 automatic worm-thread grinding machine recently developed by the Brown & Sharpe Mfg. Co., Providence, R. I. This machine has been successfully applied to a wide range of work, including worms for machine tools, automobile truck drives, turbines, elevators, and domestic oil burners. Worms can be ground with

threads of all sizes up to 1 1/8 inches deep, either right- or left-hand, and with any practical number of threads of any lead and pressure angle. The machine swings worms up to 8 inches in diameter, and the maximum length between centers is 24 inches.

One side of a thread is ground at a time, the worm being turned end for end to grind the opposite side. The grinding wheel operates while the table is traveling in one direction, and is withdrawn for the table return. Multiple-thread worms are indexed during the return stroke. The wheel-spindle is mounted on the upper of two slides, the lower one being automatically fed to and from the work by a hydraulic arrangement. A travel of 1 1/4 inches is provided, so that the wheel clears the work while the worm is indexing and the table returning to the cutting position.

Provision is made to swivel the wheel-spindle through 180 degrees to permit grinding worms of either hand. A diamond that is adjustable to the required pressure angle is used to keep the wheel shape correct. The wheel is moved in to the diamond, and is therefore always in proper position relative to the worm center line. A water-tight steel sleeve encloses the wheel-spindle. End thrust and belt pull are taken by ball bearings.

Power is furnished by two electric motors. A five-horsepower dynamically balanced ball-bearing motor mounted on the wheel-slide drives the wheel-spindle through a belt, while a three-horsepower motor on the rear of the machine operates the rest of the mechanism. Both motors are controlled through push-buttons.

The table travel is controlled by means of adjustable dogs. Ten table feeds are provided, the change from one feed to another being easily made by turning a handle at the front of the machine. The depth of cut is controlled by moving the table endwise toward the grinding wheel, which may be done by hand or automatically after each complete revolution of the worm. Throw-out shoes on the feed ratchets permit a predetermined amount of stock to be ground off.

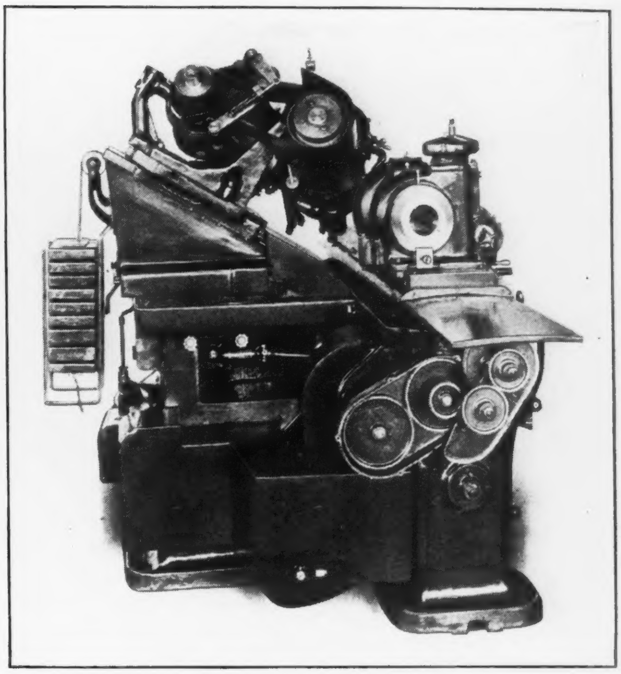


Fig. 2. Left-hand End of Machine

Indexing is accomplished through change-gears on the left-hand end of the bed, which may be seen in Fig. 2. A safety device prevents the work from being indexed while the wheel is grinding, and keeps the wheel from moving into the cutting position before the indexing is completed. The piece is indexed after each pass of the wheel, so that any variation due to wheel wear is distributed over the different threads of the worm being ground. The correct lead is obtained through change-gears located on the right-hand end of the machine, as illustrated in Fig. 3. Different combinations of change-gears are used for different leads in the same manner as when cutting "leads" on a milling machine.

The headstock spindle has a hole 3 inches in diameter extending through it, so that if it is not possible or desirable to use centers, worms with shafts 3 inches or less in diameter can be ground from their own journals. One end of such a shaft may be inserted in a bushing in the headstock, and the other end in a bushing in a special footstock. This feature is particularly useful when the worm-shafts are longer than 24 inches.

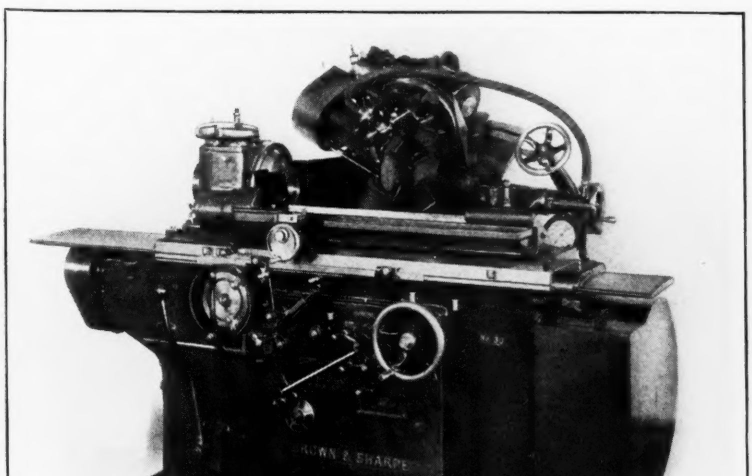


Fig. 1. Brown & Sharpe Automatic Worm-thread Grinding Machine

The hydraulic arrangement for operating the wheel-slide is very simple. It is automatically controlled by a rotary valve and a standard Brown & Sharpe No. 3 pump. The length of the movement is constant, and the slide is held under pressure against fixed stops at one end of the stroke for grinding, and at the other end for indexing. Fine adjustments are obtained by means of screws.

Lubrication of the working parts in the interior of the machine is accomplished by oil pumped from a reservoir. Coolant is pumped from a tank conveniently located at the side of the machine in a position where it can be easily cleaned. The machine is well guarded at all points, and

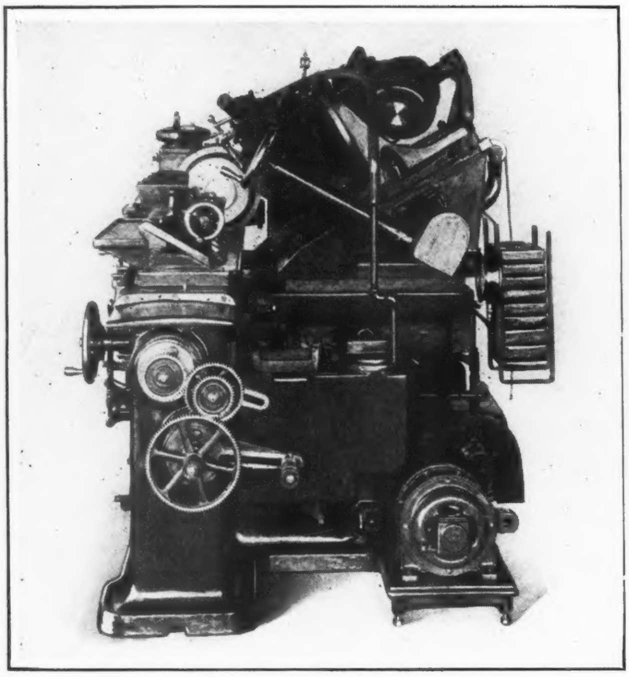


Fig. 3. Close-up View of Right-hand End

careful design prevents dust and particles of abrasive from getting into the operating mechanism. All controls, including those for indexing and for withdrawing and advancing the wheel-slide, are conveniently located at the front of the machine. The position of the wheel while cutting is such that the operator is able to see the work.

"NATCO" DRILLING AND TAPPING MACHINES

Three new horizontal-type machines—a three-way hydraulic multiple-spindle driller, a three-way multiple-spindle tapper, and a two-way hydraulic multiple-spindle driller—are recent developments of the National Automatic Tool Co., Richmond, Ind. The first two machines mentioned drill and tap all the holes in three sides of a transmission case at the rate of 120 cases per hour. The operator merely loads and unloads the fixtures of these machines and starts the movement of the heads, the machines automatically completing the cycle. The fixtures of both machines are opened and closed with a single motion of the clamping lever.

As may be seen from Fig. 1, the driller is composed of three duplicate units, which are grouped around a central table casting. Each unit is equipped with separate valves and tripping mechanism, so that it can be set individually for rapid traverse, feed, and reverse. The three members are centrally controlled for starting and emergency reversing from one valve located at the working position of the operator.

The feeding rate can be set to anything from 0 to the rapid traverse rate of 75 inches per minute, the feed being limited only by the capacity of the drills. In actual operation, the machine has drilled 21 holes in the three sides of four castings in one minute. The deepest hole was 0.332 inch in diameter and extended through a wall 21/32 inch thick.

An important feature of the tapper, shown in Fig. 2, is that a patented lead-screw feed is provided for each spindle. Each spindle has its own feeding mechanism, so that holes of different sizes and leads may be tapped at the same time. A thread on the shank of each spindle is of the same lead as the tap driven by that spindle. The spindle revolves in a stationary bronze nut, and at each revolution, it feeds the tap forward the correct amount. This arrangement is said to insure a true thread in every hole and to increase the life of taps.

The entire feed mechanism is carried on a heavy plate which is bolted to the front of each head. The bronze driving nuts are held in this plate by means of split springs on the front side and flanges on the back. These flanges each have four grooves in them, 90 degrees apart, in which adjustable slides fit and lock the nuts in place. After loosening these slides, the nuts may be turned and the spindles set for tapping to any desired depth.

The split springs on the front serve as a safety device. Should a tap strike a broken drill or other obstruction, the spring will release the driving nut and run back on the spindle shank, instead of forcing the spindle forward and breaking the tap. This safety feature is said to practically eliminate tap breakage.

The machine illustrated is equipped with a countershaft drive, but a direct motor drive can be furnished. The two levers on the front of the machine are for starting and emergency reversing. All bearings are lubricated from tank oilers, which have an individual connection to each bearing. The lead-screws are also lubricated individually.

Fig. 3 shows the two-way hydraulic driller arranged for producing ten 11/32-inch holes in one side of cylinders for refrigerating machines, and eight 1/4-inch holes in the other side. Two of these

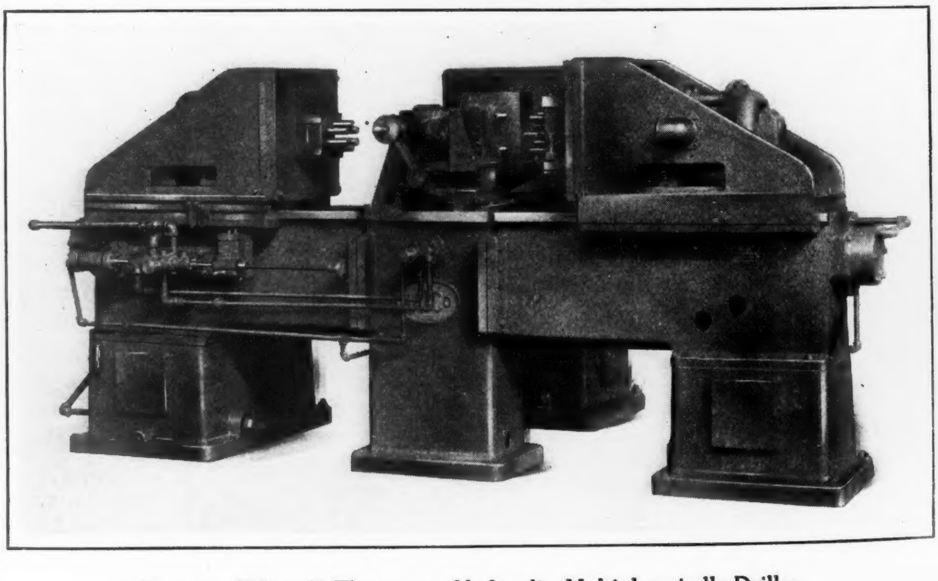


Fig. 1. "Natco" Three-way Hydraulic Multiple-spindle Driller

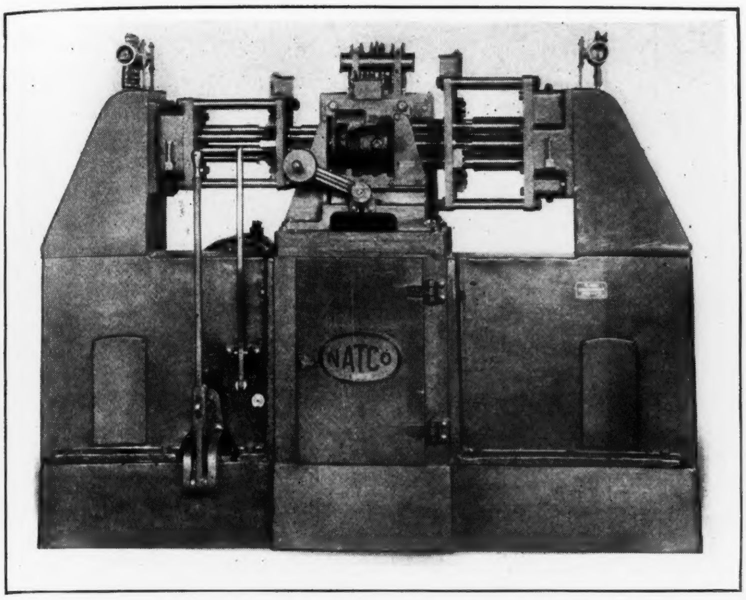


Fig. 2. Three-way Tapper with a Lead-screw Feed for Each Spindle

castings are shown on the floor in front of the machine. The production averages 170 castings per hour.

Machines of this design have also been built for drilling the top and bottom holes of crankcases. The large cluster-box area on the front of the heads makes them adaptable for drilling closely grouped or widely separated holes. Each unit is complete in itself, having an individual motor for driving the spindles, individual hydraulic cylinder, and individual feed-control mechanism. The two-position trunnion fixture permits loading and unloading of work while the drilling operation is being performed on a second piece. In case of emergency, the heads can be instantly withdrawn by pushing down on the small handles shown at the left and right of the starting button. The left-hand head is driven by a three-horsepower motor, and the right-hand head by a five-horsepower motor. The pump is driven by a three-horsepower motor and develops a pressure of 200 pounds per square inch.

In addition to the two- and three-way machines of this general design, one-, four- and five-way designs can be constructed, with the individual units grouped around a central or table casting.

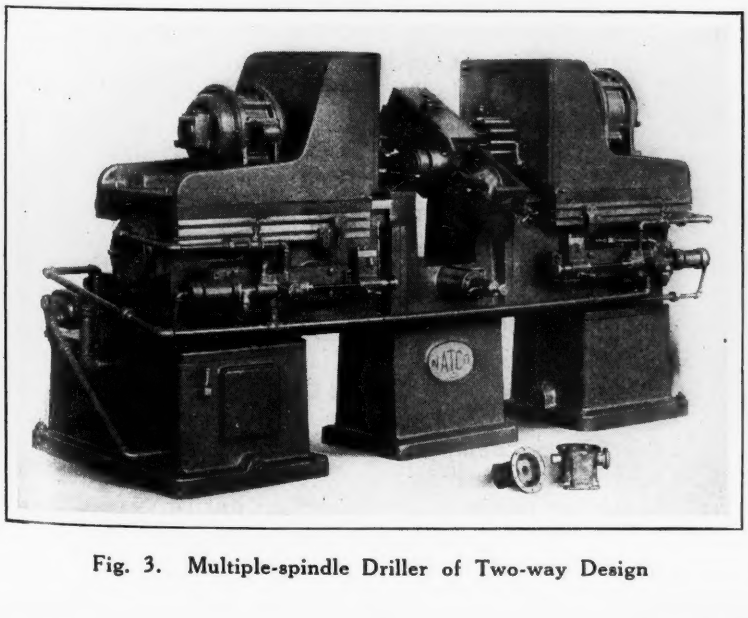
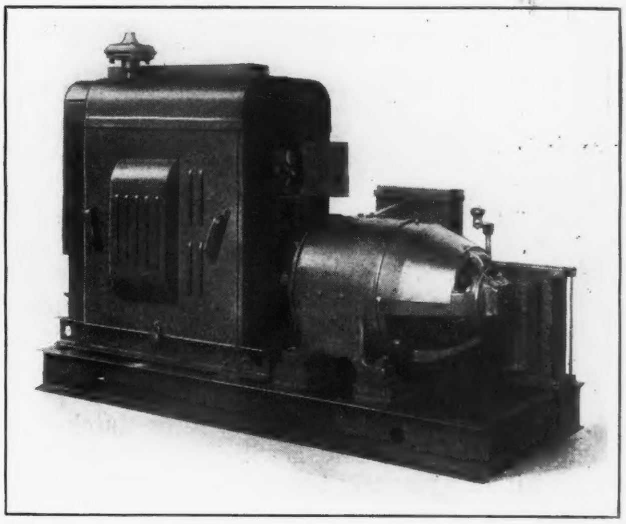


Fig. 3. Multiple-spindle Driller of Two-way Design

G. E. ENGINE-DRIVEN WELDER

A small gas-engine-driven outfit has recently been added to the line of welding equipment manufactured by the General Electric Co., Schenectady, N. Y. This set incorporates a WD-11 welding generator having a continuous rating of 150 amperes and a 1-hour rating of 200 amperes, the current range running from 50 to 250 amperes. The generator is driven by a Continental power unit capable of developing 23.5 horsepower at 1400 revolutions per minute.

The generator is equipped with a control panel, rheostat, and self-adjusting stabilizing reactor. Among the engine accessories are a pressure-feed lubricating system with a gage and indicator, vertical-tube gravity-feed carburetor, air cleaner, centrifugal governor, ten-gallon gasoline tank, and tool-box. The outfit is particularly adaptable for use in oil fields, shops, and garages, where portability is desirable or where there is no available power supply for running a motor-driven welder. It is mounted on a structural steel base so designed as to facilitate moving from place to place.



General Electric Gas-engine-driven Welder

FELLOWS ATTACHMENT FOR CUTTING INTERNAL CLUTCH TEETH

Various methods are used for cutting the internal teeth in the clutch of the second-speed sliding gear of automobile transmissions. In some cases, half-round holes are drilled and reamed in the sliding clutch member, and the forward ends of the teeth of the direct-drive pinion which mesh with the clutch teeth are rounded to correspond. In other cases, internal gear teeth are generated in the forward end of the sliding gear, and to facilitate engagement, the external diameter of the teeth on the direct-drive pinion is reduced slightly.

The "half-hole" method has been used extensively where the sliding gear has a

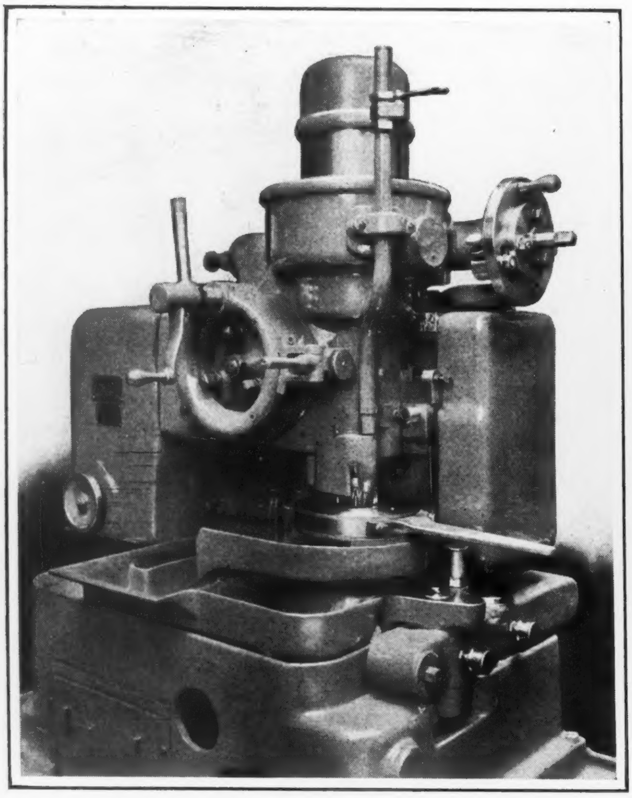


Fig. 1. Fellows Gear Shaper Equipped with "Side-trimming" Attachment

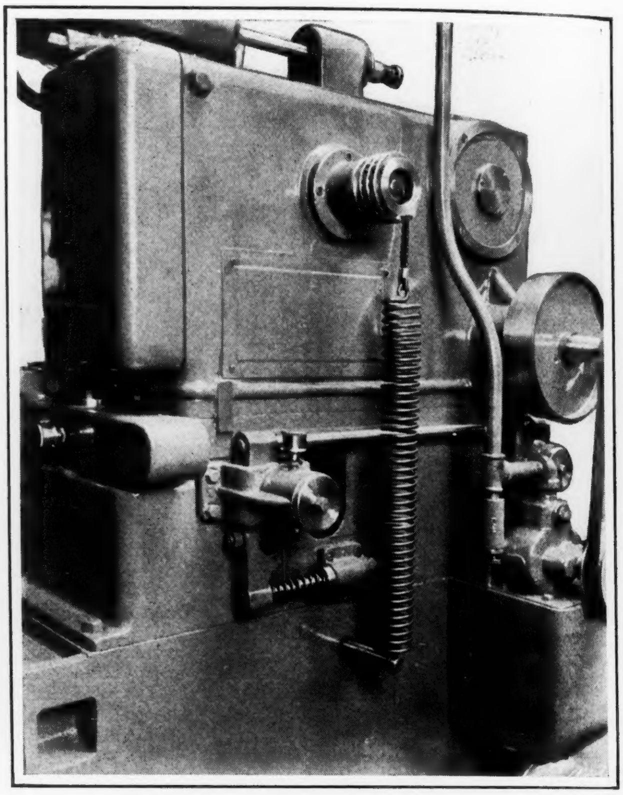


Fig. 2. Arrangement of the Special Relieving Mechanism on the Fellows Gear Shaper

hub that extends beyond the face of the gear or is flush with the face. Such a design prevents the use of an internal generating cutter for shaping the teeth. Sometimes holes are rough-drilled in the face of the sliding clutch gear, and the internal teeth are formed by push-broaches. By this means, an accurate and interchangeable product is secured, but the cost of the broaches is a considerable item.

An improved method of machining clutch gears having hubs that are flush with the face or extend beyond it has recently been developed by the Fellows Gear Shaper Co., 78 River St., Springfield, Vt. This method involves the use of a "side-trimming" gear shaper cutter which completes the teeth in the clutch after they have been roughed out by drilling. The machining is done on the high-speed gear shaper described in January, 1922, MACHINERY. The teeth are formed, not generated, and to accomplish this, the cutter is made a duplicate of the male clutch member, with the exception that the teeth are reduced in thickness and the diameter of the cutter made larger to provide for clearance. The axes of both the cutter and work coincide and, in starting, the teeth of the cutter are centered in the spaces of the work. The work is relieved from the cutter on the return stroke by imparting a slight oscillating movement to the work-spindle by means of the special relieving mechanism illustrated in Fig. 2.

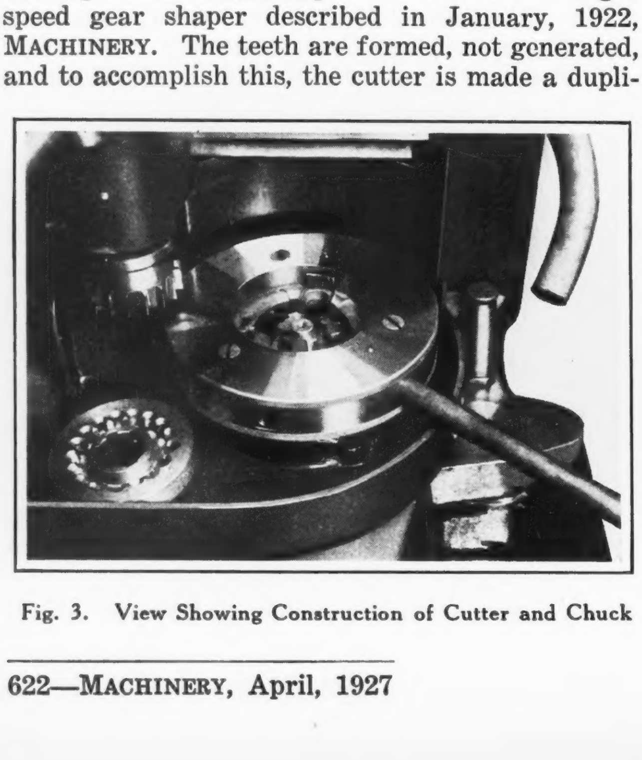


Fig. 3. View Showing Construction of Cutter and Chuck

Cutting is accomplished by rotating the cutter while reciprocating it, the extent of rotation being controlled by adjustable stops. In action, the cutter is rotated first in one direction, and then reversed and rotated in the opposite direction, thus side-trimming the teeth to any desired width of tooth space within very close limits. The adjustable stops of the feed controlling mechanism are carried in a feed dial mounted on the upper feed-rod, as shown in Fig. 1. This shaft is driven by the regular feed mechanism of the machine through a double-plate "spring-loaded" friction clutch which slips when the stops come into action.

The operation of the machine, briefly, is as follows: The operator places the work in the chuck, locating it by means of the splined arbor in the chuck, which may be clearly seen in Fig. 3. He then clamps the work by operating the chuck handle. The saddle is next advanced to a stop, which locates the axes of the work and cutter centrally, after which the cutter is centered with the spaces in the work by rotating the feed dial until a spring plunger enters a centering notch.

Next, the operator starts the machine by moving the countershaft shipper rod, and the cutter continues to cut in one direction until the feed is disengaged. The machine is then reversed by operating the shipper rod of the reversing counter-

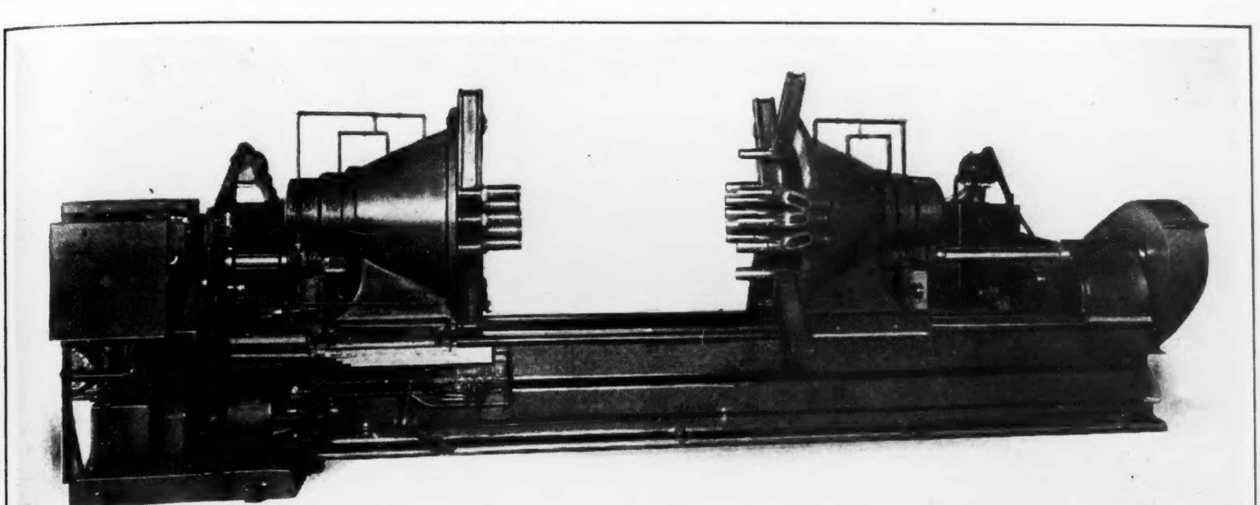


Fig. 1. Harrington Opposed-head Multiple-spindle Drilling Machine Provided with Oilgear Equipment for Operating the Heads Automatically

shaft, and the feed dial is returned by hand to the central position. Cutting now continues as before, but on the opposite sides of the teeth, until the stop disengages the clutch. The machine is then stopped, the saddle backed off to withdraw the cutter, and the work removed from the chuck.

The entire operation of cutting is a matter of seconds only, and as the machine can be quickly operated, work can be produced rapidly. On most clutch gears, the floor-to-floor time is seldom more than 2 minutes per gear.

HARRINGTON HORIZONTAL HYDRAULIC DRILLING MACHINE

Hydraulic equipment is employed to impart rapid-traverse, feeding, and quick-return movements to both heads of a horizontal two-way multiple-spindle drilling machine recently built by the Harrington Co., 17th and Callowhill Sts., Philadelphia, Pa. This machine was developed primarily for use in conjunction with vertical multiple-spindle drilling machines of the construction described in March MACHINERY. The vertical machines are intended for drilling the web of heavy steel girders up to 31 inches in height, and the horizontal machine will be used for drilling both flanges of these girders simultaneously. The flanges range up to 16 inches in width.

Both heads are actuated by an Oilgear pump unit, which consists of a constant-delivery low-pressure pump for imparting rapid-traverse and quick-return movements, and a variable-delivery high-pressure pump for producing the feeding movements. The two pumps deliver oil under pressure to cylinders mounted between the ways at each end of the bed. The piston-rod extending from each cylinder is connected to the corresponding head.

Flexible control of the head movements is obtained by means of a mechanism which operates the control valve of the hydraulic system. This mechanism is fastened to the left-hand head, as shown in Fig. 2, and is of the same general design as the mechanism used for controlling the feeding movements of the head on the vertical machine. The mechanism consists primarily of three bars *A* of slightly different widths, which may be so positioned in holder *B* as to give various lengths of rapid-traverse and feeding movements. The amount of the rapid traverse and feeding movements depends upon the location of the left-hand end of the respective bars.

At the beginning of an operation, with both spindle heads in their extreme positions toward the ends of the bed, pedal *C* is depressed to open the control valve of the Oilgear pump. Coincidentally, an operating trigger *D*, which is connected to the control valve, is brought into contact with the outer and widest of bars *A*. Both spindle heads then travel toward the center of the machine at a rapid rate until trigger *D* slides off the outer bar and comes in contact with the middle one. This action causes automatic reduction of the head movements to a coarse feed, which is maintained until the trigger slides off the second bar and into contact with the third. As this occurs, a fine feed for both heads is engaged until the trigger reaches

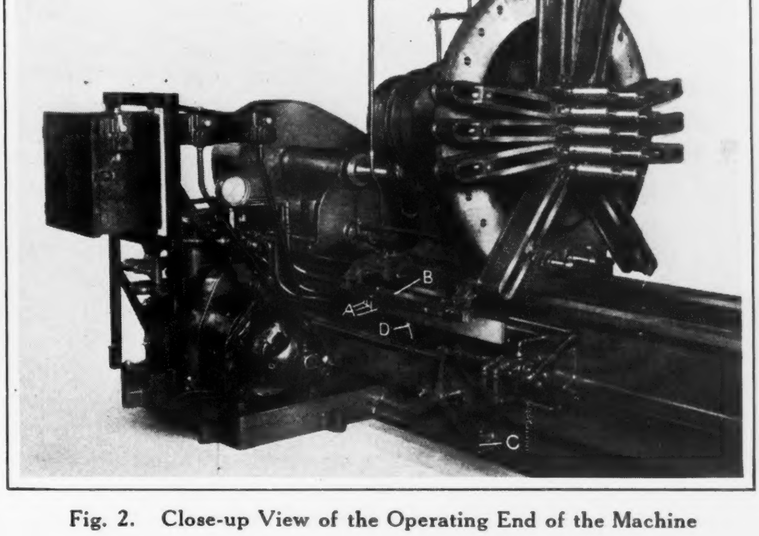


Fig. 2. Close-up View of the Operating End of the Machine

the end of the third bar. The quick return is then automatically obtained to carry both heads back to their starting positions. When these positions are reached, the Oilgear pump automatically stops delivering oil until pedal *C* is again operated.

Uniform movement of both heads is insured through a connection made between the two heads. Each head is equipped at the rear with a horizontal bar on which rack teeth are cut. An idler pinion mounted on a stud at right angles to the bed engages each rack; thus both heads must move in unison, regardless of the natural tendency of one head to move faster than the other from some such reason as tighter stuffing-boxes or quicker contact of drills with the work.

Safety is a feature of the hydraulic system, as a relief valve functions to stop head movements if a head or drills become jammed against the work or other objects. The pump motor can also be stopped instantly by means of the stop-button of the proper push-button switch mounted on the panel to the left of the operator. A gage indicates just what pressure is being used in the hydraulic system at any time, and gives an indication of dull drills, etc.

The heads are driven by separate 40-horsepower motors, which are located at the opposite ends of the bed. Both motors are controlled through the push-button switches near the left-hand end of the machine. Power is conveyed from the motors to the head units through gears and Morse silent chains 8 inches wide. Each head has a capacity for drilling up to twelve 1 5/16-inch holes through steel.

As on the vertical machine previously described, two complete sets of spindles are furnished for each head. The No. 9 spindles are intended for driving up to 1 5/16-inch drills, spaced at minimum center distances of 2 3/4 inches, and the No. 6 spindles, for driving up to 7/8-inch drills, spaced at minimum center distances of 2 1/4 inches. Rapid interchangeability of these spindles has been provided for. All spindle units are of the patented "Screw-Lock" type, and "Oil-Well" universal joints are furnished. Quick-change chucks enable drills to be rapidly inserted or removed to suit the number of holes to be produced at various points along a girder or other work.

Lubrication is supplied copiously to all spindle units by a pump mounted on each head. These pumps draw oil from a pocket in the corresponding head and deliver it through sight-feed oilers to the spindle gears. From these gears, the oil cascades over the universal joints and finally returns to the pocket. All spindle gears are made of alloy steel.

Other details of the machine not specifically mentioned are the same as on the standard No. 63-B horizontal multiple-spindle drilling machine built for several years by the Harrington Co. The maximum diameter of circle to which the drill spindles can be set is 29 3/8 inches; the distance from the center of each head to the top of the bed, 23 inches; and the over-all length of the machine, 22 feet 11 inches.

GISHOLT STATIC BALANCING MACHINE

A static balancing machine designed for flywheels, clutches, automobile wheels and wheel parts, pump impellers, and other narrow-faced parts is being introduced to the trade by the Gisholt Machine Co., Madison, Wis. By a simple process, this machine shows the amount and location of the correction required to place work in static balance. The machine is intended to be used as a production tool, it being possible to determine the correction necessary and to make that correction on twenty-five or more pieces every hour in regular production work. A drill spindle is incorporated in the machine, so that parts can be drilled for correction without removing them from the machine. One of the principal features is simplicity of operation, it being stated that a new operator can become proficient within one-half hour.

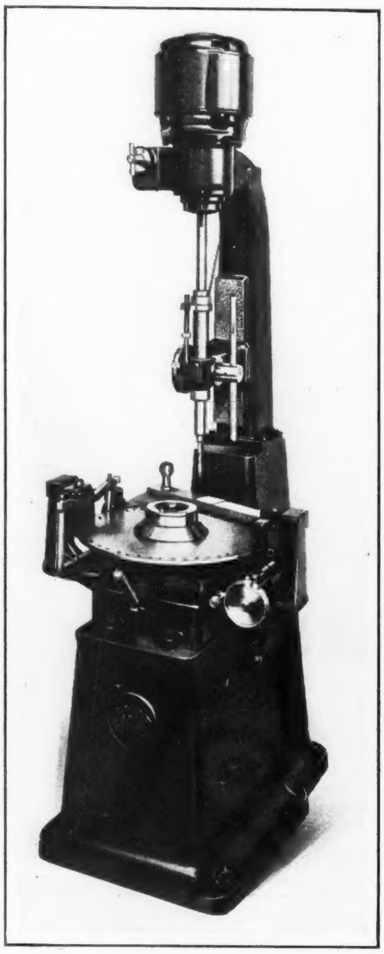


Fig. 1. Gisholt Static Balancing Machine

In operation, the part to be balanced is mounted on adapter *A*, Fig. 2, with its axis in the vertical position. The adapter is mounted on a vertical spindle *B*, which is carried on a cradle supported on two special pivots that allow the cradle to rock in one plane only. When the machine is in operation, the heavy side of the piece throws the cradle out of level, and the direction of the heavy side is indicated by spirit level *C*.

Dial *D* is connected to the cradle by means of a special "weighing" spring. The tilt of the cradle is corrected by turning this dial in the direction indicated by the level the amount necessary to return the bubble of the level to dead center. Slider *G*, Fig. 3, is then set to indicate on scale *H* the first reading of dial *D*, Fig. 2.

The part being balanced is next turned 90 degrees about its axis, as indicated by graduations on dial *E* of the cradle. This changes the position of the unbalance with respect to the pivot axis, the cradle, with the piece, again being out of level. The condition of being level is then restored, and a second reading noted on dial *D*. Protractor scale *K*, Fig. 3, is next moved until a reading corresponding to that of dial *D* is uncovered on slider *G*.

Correction readings are then taken, first from protractor *M* and second from scale *K*. From protractor *M* is determined the angular position to

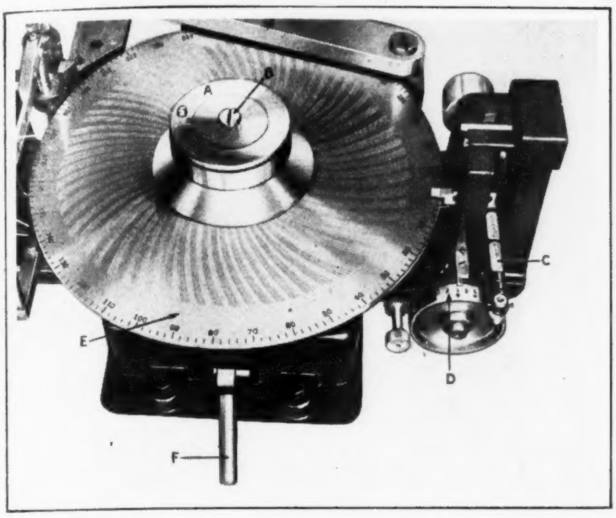


Fig. 2. Close-up View of Work Adapter and Cradle Dial

which dial E must be set to bring the heavy side of the work under the drill. Scale K indicates the depth to which the holes are to be drilled and the number of holes. Without handling the piece, the motor-driven drill spindle is then easily brought into action to remove the necessary material for establishing static balance in the part. Thus the operation of the machine consists simply of bringing the frame to level, turning the piece 90 degrees, again bringing the frame to level, drilling

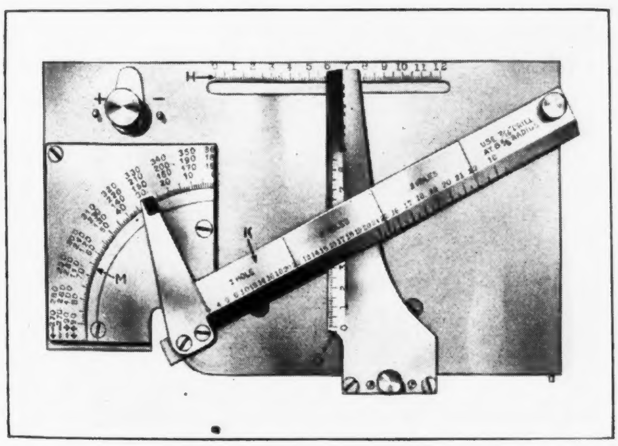


Fig. 3. Scales and Protractor Used in Determining the Correction to be Made

out the required amount of material, and checking the correction.

Lever F, Fig. 2, provides for lifting and rigidly locking the table to protect the pivots from possible shocks occasioned in loading, unloading, and correcting the work. It is stated that in actual production work, the machine measures and locates static unbalance to within two-tenths of an ounce-inch. The machine regularly handles narrow-faced parts up to 18 inches in diameter, weighing up to 150 pounds, but it can be furnished to accommodate larger work. The floor space required is only 19 by 33 1/2 inches.

BILTON AUTOMATIC CAM MILLING MACHINE

Cams for automobile four-wheel brake mechanisms are produced at the rate of 80 per hour in a machine recently developed by the Bilton Machine Tool Co., Bridgeport, Conn. These cams are steel forgings. The machine is a special adaptation of the No. 3 1/2 "Producto-Matic" which automatically mills the cams to the desired outline and stops when each operation is completed. Simple modifications can readily be made to adapt the machine to the production of other small cams of the plate type.

From Fig. 2 it will be seen that the cutter is held in the spindle of head A and the work in the collet of a spindle in head B. Work-head B remains stationary during an operation, its spindle revolving so as to bring the entire periphery of the cam into contact with the milling cutter. Cut-

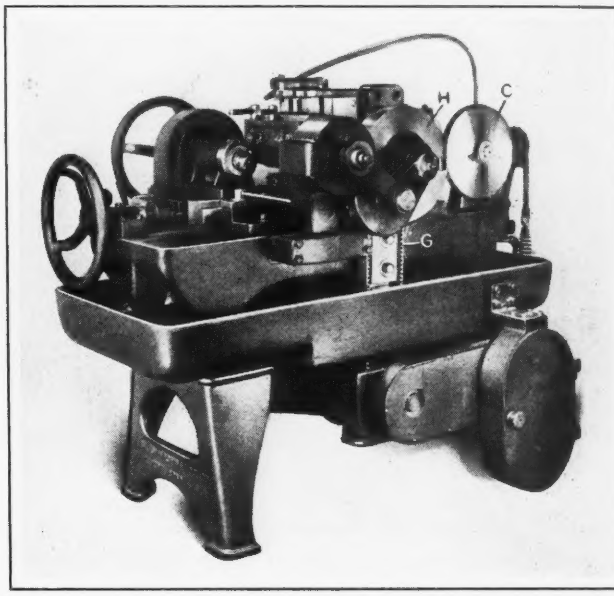


Fig. 1. Bilton "Producto-Matic" Arranged for Milling Cams

ter-head A is mounted on a slide, and this unit is moved back and forth horizontally to suit the cam outline.

Accurate movement of the slide and cutter-head is obtained through master cam C, Fig. 1. This cam is of the path type, having the path on the inner side. A roller fastened to the cutter-head slide engages the cam path and through this connection the slide and cutter-head are advanced and returned as cam C revolves. The position of the roller is adjustable on the slide. Spring tension holds the roller in close contact with the cam path

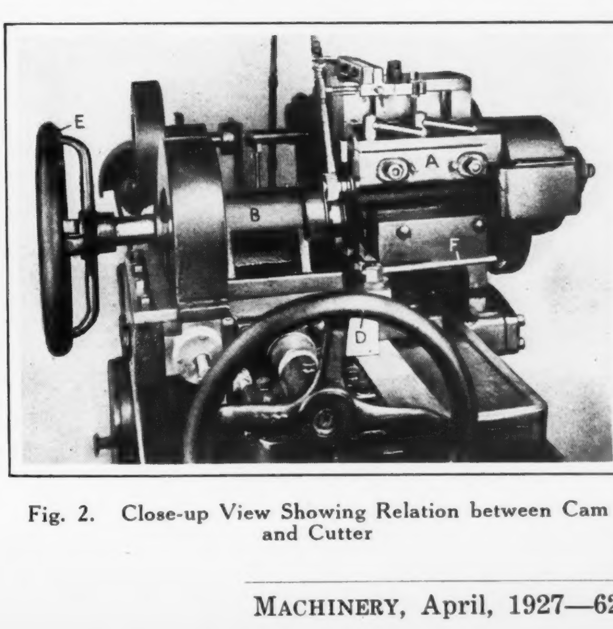


Fig. 2. Close-up View Showing Relation between Cam and Cutter

at all times. The cam path is ten times the actual size of the work outline.

Before an operation is started, handwheel *D*, Fig. 2, is revolved to bring work-head *B* forward away from the cutter so that it can be loaded. Handwheel *E* is then rotated to open the work-holding collet, the work is inserted, the collet closed by revolving handwheel *E* in the opposite direction, and handwheel *D* again revolved to move the work-head back against a micrometer stop. Lever *F* is then operated to clamp the work-head in place ready for operation.

The machine is driven by a motor at the rear. Power is delivered to both the work-spindle and the camshaft through worm and spur gears which revolve the camshaft at exactly the same rate as the work-spindle. Changes in the speed of these shafts can be obtained through pick-off gears in a feed-box. The drive to the cutter-spindle is through chain *G*, Fig. 1, and gears, from a second gear-box in which pick-off gears are used to provide various speeds. Flywheel *H*, which is keyed on the shaft of a gear in the drive to the cutter-spindle, insures uniform momentum of this spindle. The cutter-head is adjustable vertically on the slide.

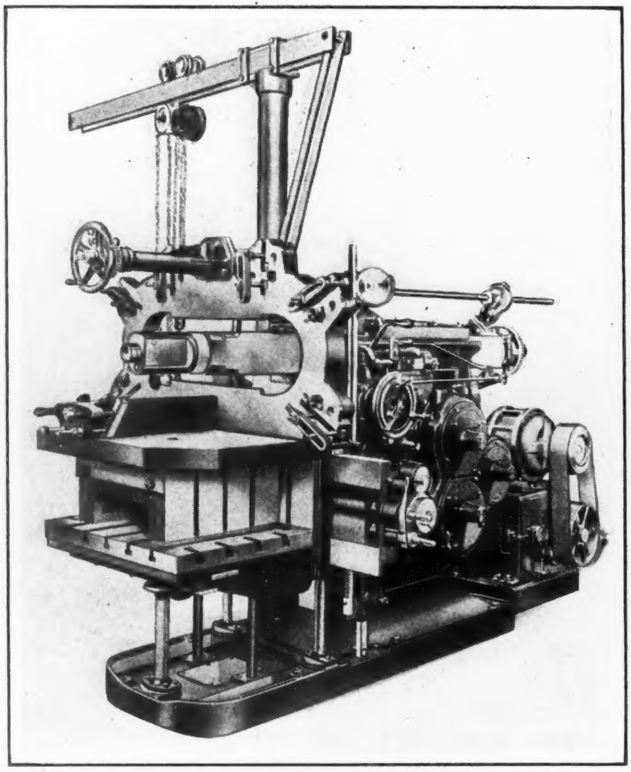


Fig. 1. Morton Special Railroad Shaper Equipped with Improved Double Chuck

MORTON RAILROAD SHAPER AND ATTACHMENTS

An improved heavy-duty draw-cut shaper designed especially for railroad work has recently been brought out by the Morton Mfg. Co., McKinney Ave. and Hoyt St., Muskegon Heights, Mich. This shaper has a cutting stroke of 36 inches, a horizontal feed of 36 inches and a vertical feed of 21 inches, all of which are obtained automatically and can be changed while the machine is in operation. This shaper provides for finishing railroad shop work on a production basis. In many details, the machine is similar to that described in May, 1921, MACHINERY.

Driving-boxes can be slotted and finished complete, and the machine can be equipped with a shell or crown-brass planing attachment, shoe-and-wedge attachment, rod-brass attachment, and a special chuck for holding driving-boxes while finishing the shoe and wedge fit. In Fig. 1 the shaper is shown provided with an improved double chuck which is used in slotting driving-boxes. Adjustable stops and binders are employed to secure driving-boxes of various sizes in the chuck. One of the advantages claimed for this device is the large saving of time effected in setting up work.

Fig. 2 shows the shaper equipped with the shell or crown-brass planing attachment. The work is held rigidly, since the cutting strain comes against the rear head of the attachment and is transferred through backing screws to the face of the shaper column. Heavy cuts and coarse feeds may be taken. A hooking or shearing tool may be used for roughing, it being stated that this practice increases the cutting efficiency by reducing the friction. Through the use of a slightly concave tool for finishing, a true surface may be obtained with

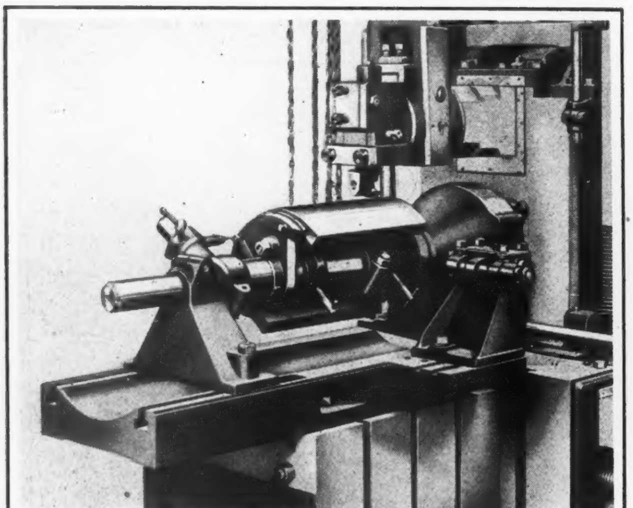


Fig. 2. Construction of the Shell or Crown-brass Planing Attachment

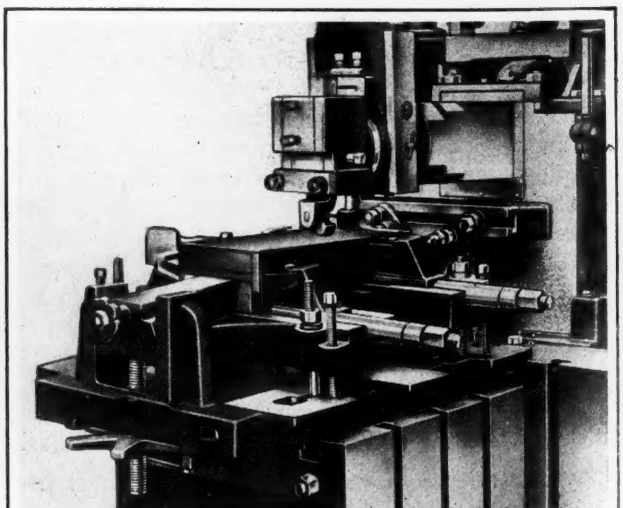


Fig. 3. Attachment Designed for Use in Machining the Face Bearing of Shoes and Wedges

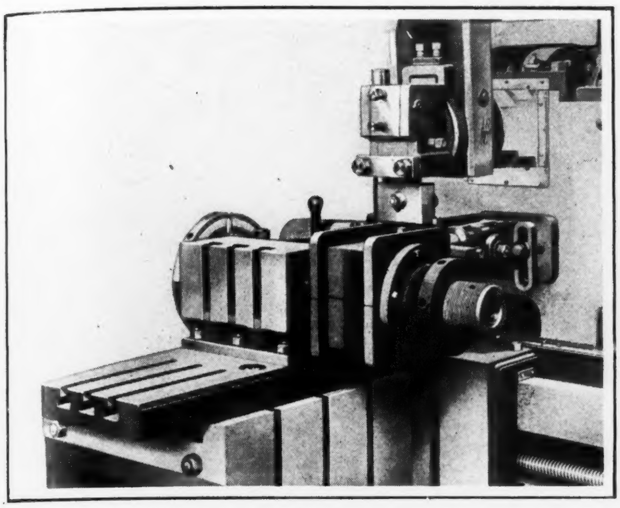


Fig. 4. Design of the Connecting-rod Brass Attachment

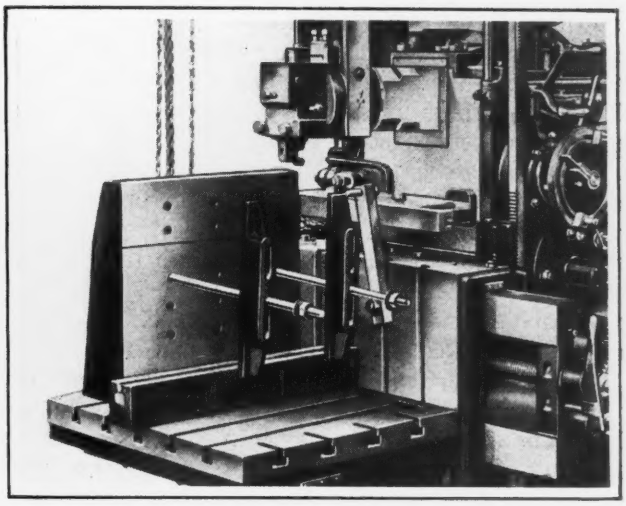


Fig. 5. Special Chuck Used in Machining Driving-boxes

the lines cut in the same direction as those cut in the driving-box. This method of machining insures a good bearing. Crown brasses finished in this way may be pressed into driving-boxes with only one binding of the work.

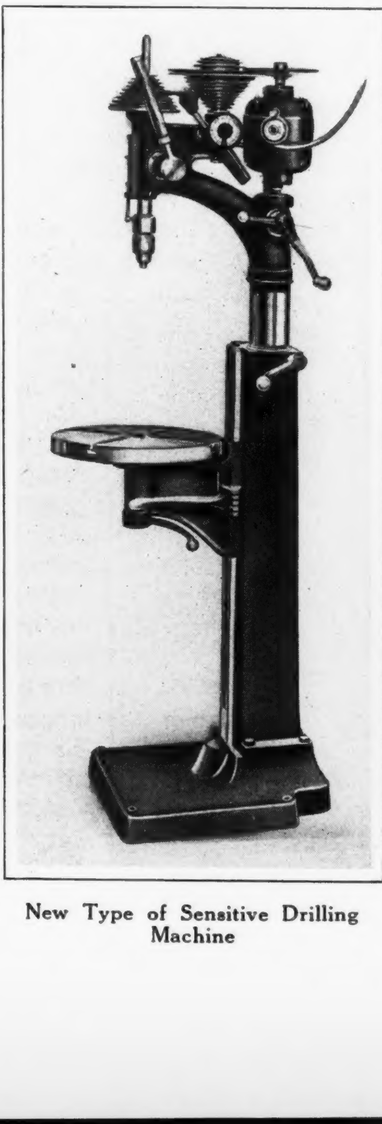
The shoe-and-wedge attachment is designed for finishing the face bearing of shoes and wedges after they have been laid out and lined. As may be seen from Fig. 3, the construction of this attachment is such that it may be quickly adjusted to meet various angular requirements. The shoe and wedge are secured in the attachment before adjustments are made, thus saving time often lost in shimming up. One roughing and one finishing cut are taken on these parts to obtain the desired accuracy.

The rod-brass attachment is designed to hold various sizes of connecting-rod brasses while machining the strap fit. This attachment is shown in place on a shaper in Fig. 4. With the chucking arrangement provided by the attachment, it is unnecessary to sweat the parts together before machining. Provision is made for setting the attachment at angles of 45 degrees to permit shaping off the corners of the brasses without extra set-ups.

The special chuck designed for holding .driving-boxes .while machining the shoe and wedge fit is illustrated in Fig. 5. This chuck permits a quick set-up of the work, and in conjunction with the stock-removing capacity of the shaper, enables the operation to be performed on a production basis. The dovetail angular slots are easily cut by shifting the bracket and the box on the table to the desired angle.

"LITTLE GENERAL" SENSITIVE DRILLING MACHINE

Several radical departures in the design of sensitive drilling machines are incorporated in the "Little General" now being placed on the market by Joseph T. Ryerson & Son, Inc., 16th and Rockwell Sts., Chicago, Ill. Belts and gears have been entirely eliminated, the principle of the drive transmission being known as the "V-Disk."



New Type of Sensitive Drilling Machine

In this drive, a disk made of fiber and tapered to an 18-degree angle meshes with grooves on the cone pulleys, effecting a substantially positive drive. A direct-reading speed-shift dial indicates eighteen different speeds and the drill speed best adapted to drilling the various materials.

The spindle may be swung in a complete circle around the column, thus enabling the operator to reach large and heavy pieces of work in any position. The table may be swung around a semicircle, and both the table and head have a large vertical adjustment. Other advantages claimed are the long reach from the drill to the column, the small number of levers and working parts, and the quick and convenient provisions for shifting and adjusting. An accurate depth gage, graduated in both inches and millimeters, is furnished. The machine will receive straight-shank drills up to 1/2 inch in diameter. By using drills with turned-down shanks, it is possible to drill 1-inch holes in brass and cast iron.

PFAUTER GEAR-HOBBING MACHINES

A number of improvements have been made in the construction of Pfauter automatic gear-hobbing machines since the description of the No. 4 machine was published in April, 1926, MACHINERY. The O. Zernickow Co., 15 Park Row, New York City, is the American agent for these machines. The machines have been made heavier and more powerful throughout, and the main upright driving shaft is now equipped with a flywheel at the bottom. A flywheel can also be furnished on the cutter-head when desired. Both the upright and the bed are wider and heavier.

The cutter-head slide is wider, and the cutter-head has been re-

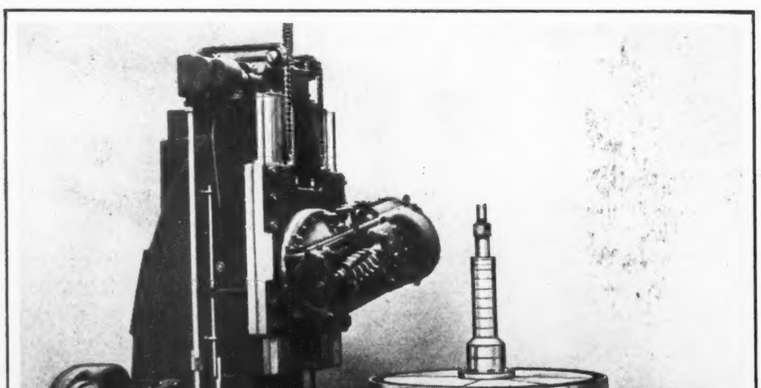
designed in other ways to reduce the overhang to a minimum. All the controls employed in running the machine have been concentrated on the front side, so that it is unnecessary for the operator to change his position when reversing the cutter-head or table or when setting the depth of cut. In the latest table design, the bore has no obstruction below which would interfere with passing a pinion that is integral with the shaft through the hole in the table. This hole extends to the floor. The cone pulley drive has been eliminated, and the machines are now arranged with a single-pulley drive.

After a thorough study of the problem of whether change-gears or a gear-box should be provided, change-gears were selected. It is pointed out that often, in operating a gear-hobber, the speed of the hob need not be changed for weeks and even months. With change-gears, the same number of gears are always in mesh and idler gears are eliminated. The change-gears for controlling the hob speeds are located in a cast-iron housing equipped with a hinged cover.

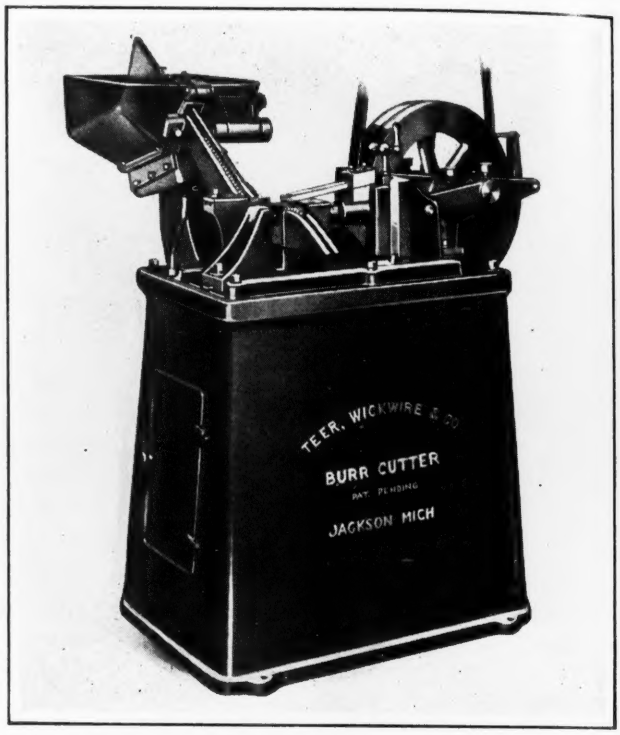
Change-gears are also employed for obtaining an unlimited number of feeds. There is incorporated in the feed mechanism an ingenious device which permits the operator to obtain three different feeds with one set of change-gears by simply manipulating a "push-pull" spindle. For instance, if the machine is geared to give a feed of 0.040 inch, the operator can change the feed to 0.060 and 0.080 inch without changing gears.

The patented hydraulic table-load balancing device with which the machine is provided has been completely redesigned and simplified. A small motor equipped with a pressure gage is mounted directly on the table base at the rear of the machine. This arrangement eliminates entirely the long telescoping oil-tubes and other piping and fittings that were formerly required. The balancing device is required only in extreme cases where the weight of gear blanks and supports exceeds 6 tons.

The main driving shaft of the improved machine runs in roller bearings, and is automatically lubricated. The single pulley has double roller bearings, the other bearings being of the ring oiling type.



Pfauter Improved Automatic Gear-hobbing Machine



Teer-Wickwire Machine for Cutting Burrs from Screw Machine Products

TEER-WICKWIRE BURR CUTTER

A fully automatic machine which removes cut-off burrs from cap-screws and other parts produced in automatic screw machines has recently been developed by Teer, Wickwire & Co., Jackson, Mich. This machine has a capacity for work from 1/4 to 5/8 inch in body diameter and up to 5 inches in length. Cut-off burrs are removed from cap-screws at the rate of 6000 screws per hour, the production rate on screws longer than 3 inches depending upon the number that the hopper will pick up.

As the machine requires no attention other than filling the hopper, an unskilled operator can handle from eight to ten machines. The screws are delivered by the hopper to parallel rails, down which they slide while hanging by their heads. At right angles to the rail there is a reciprocating slide which carries the cutting tool, a gripping jaw, and a feeding finger. On the forward stroke of the slide, the side guides on the cutting tool pass over the head of the screw to be machined and press it down firmly against the rails. The gripping jaw then grips the body of the screw and holds it rigidly while the cutting edge of the tool passes over the screw head and shears off the burr flush with the top of the head.

On the return stroke, the gripping jaw releases the finished screw, and the feeding finger feeds the column of screws one space forward, thus placing a new screw in position for the next stroke of the machine. Screws may be "burred" without injury to the threads. Changes necessary to adapt the machine to work of various diameters can be made in five minutes. The machine weighs approximately 1500 pounds.

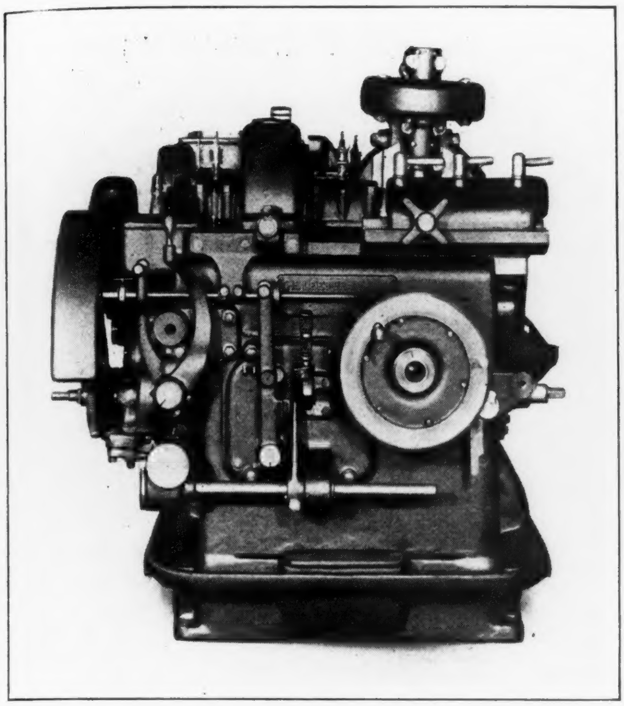


Fig. 1. Lees-Bradner Gear Generator of Recent Design

LEES-BRADNER GEAR GENERATOR

In working out the details of the No. 5 AC gear generator recently introduced on the market by the Lees-Bradner Co., Cleveland, Ohio, many of the fundamental principles successfully employed in preceding machines built by this company over a period of seventeen years have been retained. However, changes have been made where necessary to meet the conditions of present-day industry. Higher rates of production are obtainable with the new machine, it may be easily operated from one position, and it is fool-proof. One important change consists of the incorporation of a power quick-return for the work-slide. This quick-return mechanism is under the control of the operator through a lever located at the front of the machine, and carries the work-slide back to the starting point, where it is stopped automatically.

In designing this power quick-return, it was decided to use a speed of 8 feet per minute and to have the mechanism run only when required. At the rear of the machine are located the tight and loose pulleys for the main drive. As the return mechanism is used only while the remainder of the machine is idle, power for driving it is taken from a pulley that is integral with the loose pulley. When the cutting of a stack of gears has been completed, the automatic tripping mechanism throws the belt from the tight to the loose pulley and thus connects the drive for the quick return of the work-slide. However, this return does not start until the operator has first backed the hob or cutter away from the work and released the feed-screw, the control levers for these movements being interlocked.

After withdrawing the cutter and releasing the feed-screw, the operator throws over the lever that engages the clutch for the work-slide return. When the slide reaches its proper position, a collar automatically releases the clutch so that the slide stops.

In addition to this power movement of the work-slide, a hand adjustment is provided that is universal in setting up the machine for a given job; this is convenient in adjusting the position of the trip-collars which govern the feed and the quick-return movements. Hand adjustments are made by turning a crank-handle which can be mounted on the square end of a shaft projecting from the machine at the right-hand corner. A pinion on this shaft is normally held out of mesh with a gear on a sleeve of the quick-return mechanism, and to make the hand adjustment operative, it is necessary to apply the crank and slide the shaft so as to bring the pinion into engagement with the gear.

In considering the design of the quick-return movement, it must be borne in mind that there is a fixed ratio between the rotating speeds of the work-spindle and the lead-screw, and also that the work-spindle rotates much faster than the lead-screw. Consequently, the clutch for the return movement must be so located that when the lead-screw is connected to the return drive, the gear train employed to obtain the lead from the work-spindle is disengaged to save the loss of power and the wear that would otherwise result. Instead of this clutch being located near the work-spindle, as in previous designs, it is now located near the lead-screw. In order to keep the feed-lever in a constant position, this clutch is actuated by a splined shaft at the front of the machine.

The work-arbor support on the work-slide is now made with a sub-base, so that various types of standard or special supports may be applied without any setting or aligning of the slide. The joint is made on top of the sub-base, and this results in apparent advantages. The drive to the cutter swivel-head has been changed to arrange for a reverse motion by means of miter gears. This motion is quick-acting and convenient, especially when using the auxiliary head or when extreme angles are to be cut with the regular head and the

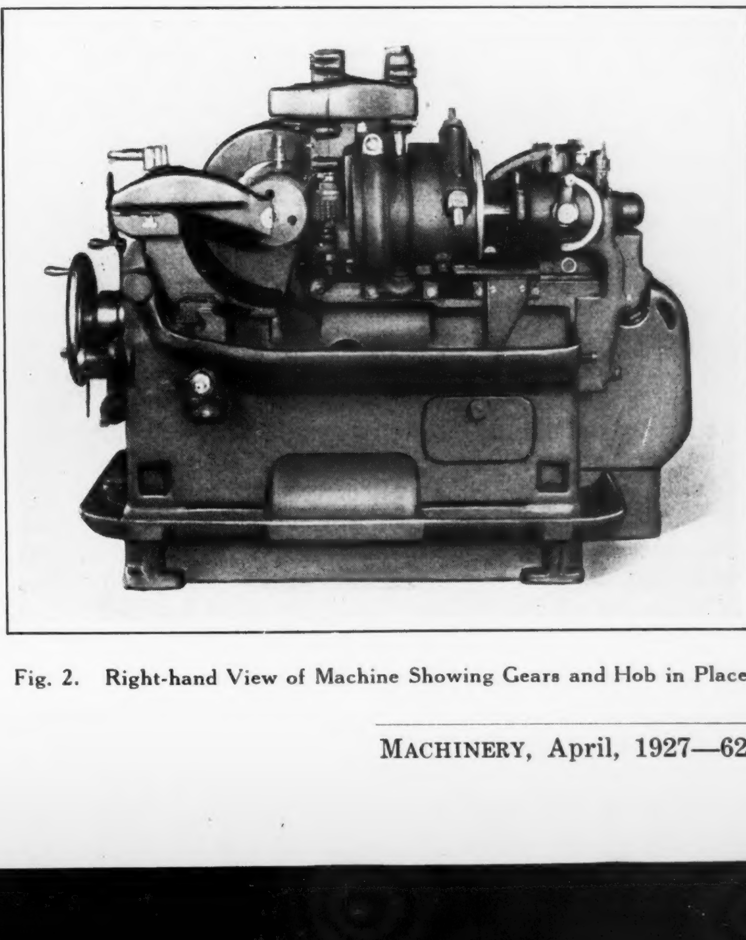


Fig. 2. Right-hand View of Machine Showing Gears and Hob in Place

head is lowered down into the side pan of the bed, the direction being changed in both cases.

The cutter swivel-head has also been so re-designed that the hob can be adjusted up or down to micrometer measurements and can be removed without swiveling the head down into the bed pan. This feature has not been made standard equipment, as experience has shown that for some work the preceding design is more satisfactory. It is furnished to special order.

For bringing the hob into depth, the micrometer principle employed is the same, except that an additional interlocking feature has been added. A block actuated by the cutter-head prevents the operator from starting the quick-return until the micrometer handwheel has made a sufficient number of revolutions to withdraw the hob from mesh with the stack of gears being cut. When this has been done, the interlocking block will have been moved out of the path of the lever that controls the return movement.

An oil-pan having a capacity for 30 gallons of coolant is now used instead of having the oil supply in the bed. A special centrifugal pump driven from the main driving pulley is employed. The pump stops automatically when work has been completed, and starts when the machine is again put into operation. It is submerged in the coolant and does not require priming.

Improved facilities have been provided for cleaning out chips. There is a large tray that catches the cast-iron cuttings, and a hoe can be used to rake the chips from this tray or the tray can be pulled out bodily and emptied. When cutting steel, the tray is removed, so that the chips can fall into a compartment having an inclined way from which they can be easily raked. A cover closes the opening in the bed whether or not the tray is being used.

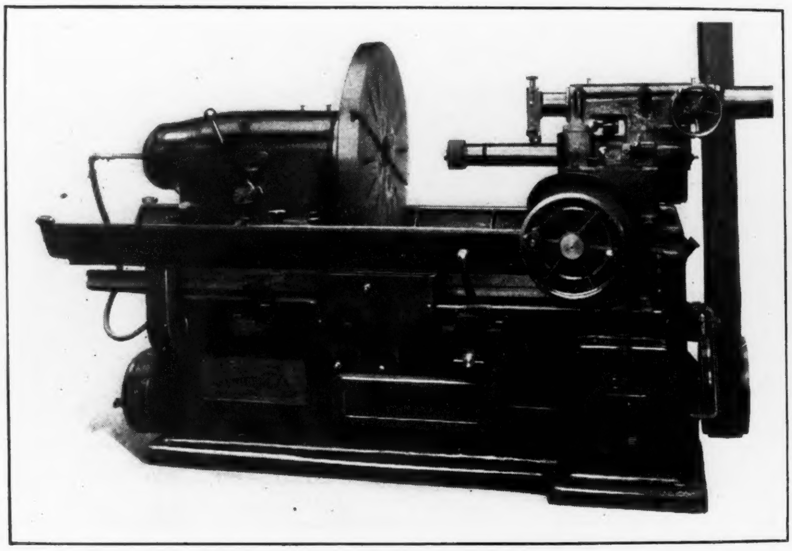
The machine is equipped with a single-pulley drive for driving direct from a lineshaft or from an individual motor. When using the special infeed, a new change-gear arm is employed in place of the previous arm. The new arm is easier to set up, as it swivels on the axis of the shaft from which the motion is transmitted. The Lees-Bradner feature of compound index has been incorporated in the machine. The work-spindle is driven through a worm-gear or a spur gear, either being instantly engaged when necessary for the production of an extremely wide range of work. The double drive makes the machine universal.

The No. 5 AC machine is equally efficient for generating spur and helical gears, worms, worm-wheels, sprocket wheels, and splined shafts, due to the 180-degree adjustment of the cutter swivel-head. The machine is made in two sizes with swings of 14 and 19 inches, respectively. Both sizes are made in standard and heavy types, the standard machine cutting steel gears up to 4 diametral pitch, and the heavy type, work up to 2 1/2 diametral pitch.

"HYDROIL" INTERNAL GRINDING MACHINES

Additions have been made to the No. 28 line of heavy-duty internal grinders built by the Greenfield Tap & Die Corporation, Greenfield, Mass. Different machines in the new series handle work up to 36 and 48 inches outside diameter. Changes and improvements made in the base and in the cross-slide that carries the wheel-head enable both machines to grind a 32 1/2-inch diameter hole with a new 10-inch wheel. Ample wheel wear is provided for, so that when the wheel is worn down to a minimum diameter of 5 1/2 inches, it is still possible to grind a 28-inch diameter hole. Also, a total stretch of 4 inches may take place in the wheel-spindle belt without reducing the hole-grinding capacity, the slack being taken up.

The new series machines are offered with different styles of work-heads. Two new designs now available are the hollow-spindle type and the heavy-duty type. The former is of plain bearing construction, and is provided with a large hollow spindle having a 10-inch diameter hole extending clear through for the accommodation of long cylinders, sleeves, hollow shafts, etc.



"Hydroil" Internal Grinding Machine of Increased Capacity

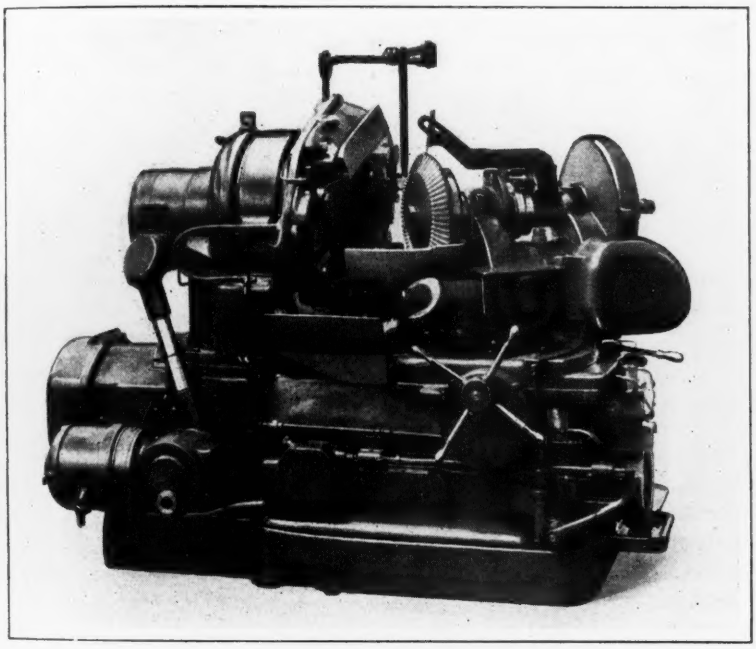
The machine shown in the accompanying illustration is equipped with the heavy-duty type of work-head. This head is of all ball-bearing construction and is designed ruggedly for taking heavy pieces of large swing. The work-spindle is started or stopped by means of an operating lever on the front of the head located within easy reach from the operator's normal position. An efficient brake brings the work immediately to rest when the lever is operated to stop the spindle. Driving of the head is accomplished by means of a belt running from a drum in the base to a jack-shaft. From this shaft power is delivered through a silent chain to the work-spindle. The work-head can be swiveled for taper grinding, and faces of work can be ground as well as holes.

These new machines have all the features of hydraulic operation and control, self-contained drive, single motor, etc., of previous "Hydroil" grinders. A description of a previous No. 28 machine was published in December, 1925, MACHINERY.

GLEASON BEVEL GEAR GENERATOR

A 12-inch generator for cutting straight bevel gears has been placed on the market by the Gleason Works, Rochester, N. Y. This machine generates the teeth with two tools, using the same basic principle to obtain the tooth shape as is embodied in other Gleason bevel gear generators. It is built as a complete unit for rough- and finish-cutting large or small quantities of gears on a quality basis at fast speeds. This statement applies to all gears having a cone distance of 8 3/4 inches or less, a ratio up to 10 to 1, and a diametral pitch of 3 or finer.

The drive for the tools is arranged to give the effect of a draw cut. On the return stroke, each tooth is mechanically relieved from the cutting surface a very small amount, and as a result, high tool speeds are safe for producing a fine quality of



Gleason Generator for Straight Bevel Gears

work. The bearing surfaces of the tool-carrying slides and arms are arranged to over-run each other. One large gib is provided on each slide to take up wear in all directions.

A rigid support has been obtained for the work-head by bolting the head base to a large sliding plate which moves on straight ways at right angles to the root line. The head can easily be withdrawn 5 inches to clear the tools. This is an advantage in removing all kinds of work or in inspecting the first tooth for size and finish without indexing around to a convenient position.

The ratio of the generating roll of the tools and work is obtained through change-gears. Indexing is accomplished by means of a mechanism of the stop-wheel type, the index change-gears being constantly under motion, as they also function as gears in the generating train. A double-roll generating method is used. By this method a rough finish is taken over the tooth while the tool-head is swinging in one direction, and a light finishing cut to complete the tooth, on the return roll. The feed cam has two tracks, one of which is used in roughing without the generating roll, and the other in finishing with the roll. Simple and convenient means are provided for engaging the cam roller with either of these tracks. Generator tools of high-speed steel are used, and they are interchangeable with those used on the 8-inch manufacturing and 18-inch bevel gear generators built by the same company.

When making a set-up, the tools and work are quickly placed in the cutting position by the use of simple gages. Slight movements are transmitted by a sensitive finger which indicates by a zero line at its longer end when the setting is correct. In mounting gears for finishing, a specially designed stock-dividing gage locates the teeth for the removal of equal amounts of stock from each side of a tooth, regardless of the stopping position of the machine.

The greater portion of the machine is automatically lubricated, and parts requiring less frequent attention are lubricated by means of a manually operated plunger pump of a "one-shot" system. Both systems are equipped with oil filters. A large amount of cutting oil may be used, as the pump which delivers this oil has a capacity for delivering 5 gallons per minute. Chips drop into a large pocket which is readily accessible for cleaning.

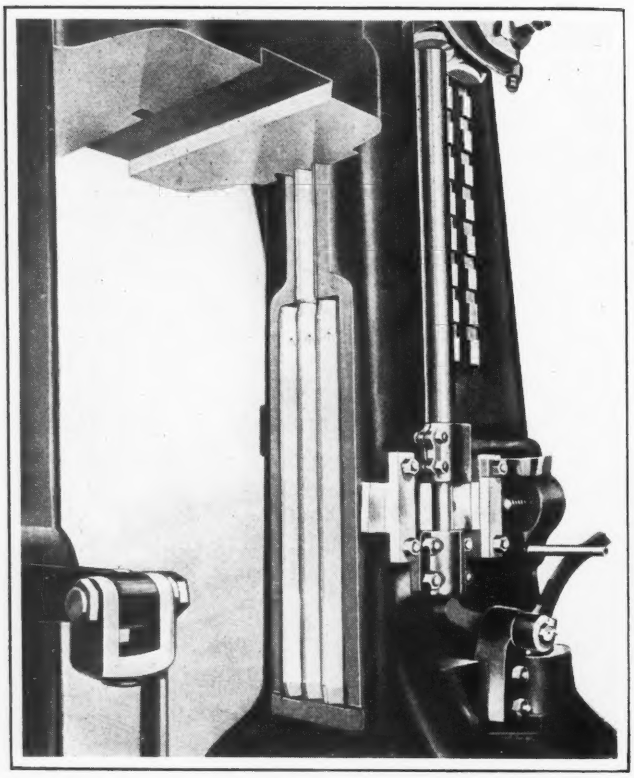
Twenty rates of feed-in are furnished, the feed-in time per tooth ranging from 14.2 seconds to 2 minutes 5 seconds. There are seventeen tool speeds, ranging from 42 to 333 strokes per minute. Standard machines are arranged with either a belt or motor drive. A five-horsepower motor of the built-in type may be used in a motor drive, as illustrated, or the machine can be equipped for coupling to a motor.

ERIE HAMMER LATCH MECHANISM

Board drop-hammers built by the Erie Foundry Co., Erie, Pa., are provided with a latch mechanism for which a patent has recently been allowed by the United States Patent Office. This mechanism, which is here illustrated, is applied to board drop-hammers having box-section frames and inserted guides.

The function of the latch is to support the friction bar in its upper position, thus holding the rolls of the hammer disengaged from the board except when the ram is being lifted. The latch also releases the friction bar, allowing it to drop and engage the rolls at the proper instant, as the ram drops and approaches the bottom of the stroke. It is claimed that the mechanism eliminates all bending and twisting strains on the friction bar, thus prolonging the life of that part. By increasing the latching areas and providing them with hardened tool-steel wearing edges, the cost of maintaining the latch is greatly reduced.

In previous designs, the friction bar seated on the end, so that the engaging surfaces were necessarily very small, and the stiffness of the springs required to hold the bar in after the edges had rounded off was so great that considerable force was required to push the bar from its seat. All



Latch Mechanism on Erie Board Drop-hammers

parts of the new latch are supported in grooves or on shoulders planed from the solid metal of the frame. No bolts are in shear.

BUFFING AND POLISHING MACHINE

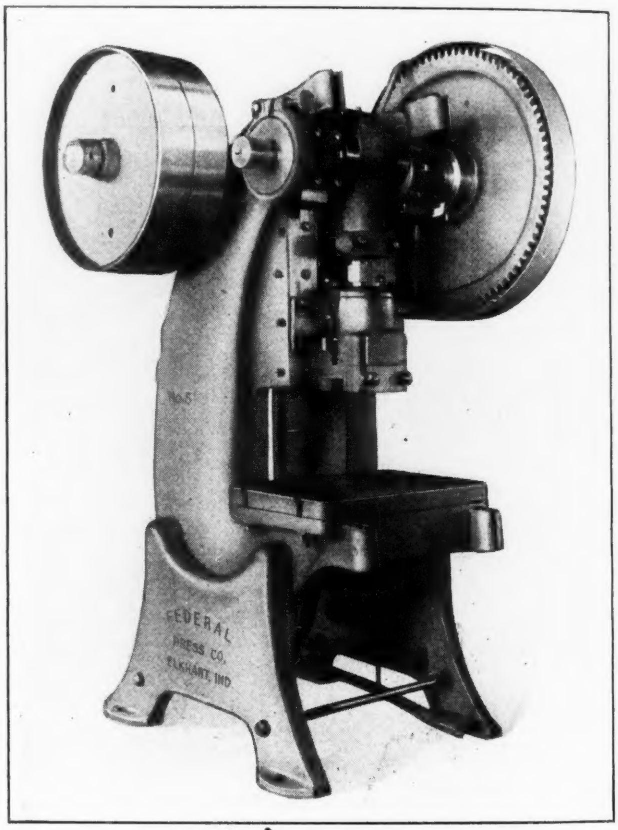
The latest addition to the line of machines built by the Standard Electrical Tool Co., 1938-46 W. Eighth St., Cincinnati, Ohio, is the motor-driven buffing and polishing machine here illustrated. This machine is manufactured in three sizes, of 3-, 5- and 7 1/2-horsepower capacity, respectively. Each size is equipped with a push-button control. The armature shaft is made of nickel-steel, and is equipped with four ball bearings. A device provides for locking the armature shaft when changing wheels. The machine can be furnished for running at a speed of 1750 or 3450 revolutions per minute.

Buffing and Polishing Machine Built by the Standard Electrical Tool Co.

FEDERAL GEARED PRESSES

Two geared presses—Nos. 4 and 5—have recently been added to the line of high-speed heavy-duty open-back inclinable presses built by the Federal Press Co., Elkhart, Ind. The new machines are made in either plain or combination geared types. To change from a plain geared to a combination geared machine, it is only necessary to attach a belt rim. The machine can then be operated either as a plain geared or a plain flywheel type.

The ram of the No. 4 machines makes forty-eight strokes per minute and exerts a pressure of 42



Federal Plain-geared Inclinable Press

tons, whereas the ram of the No. 5 machines makes forty-seven strokes per minute and exerts a pressure of 54 tons. The gearing ratio of the No. 4 presses is 5 to 1, and of the No. 5 presses, 5 1/2 to 1. The weight of the Nos. 4 and 5 plain geared presses is 4200 and 6700 pounds, respectively, and of the Nos. 4 and 5 combination geared presses, 4350 and 6850 pounds, respectively.

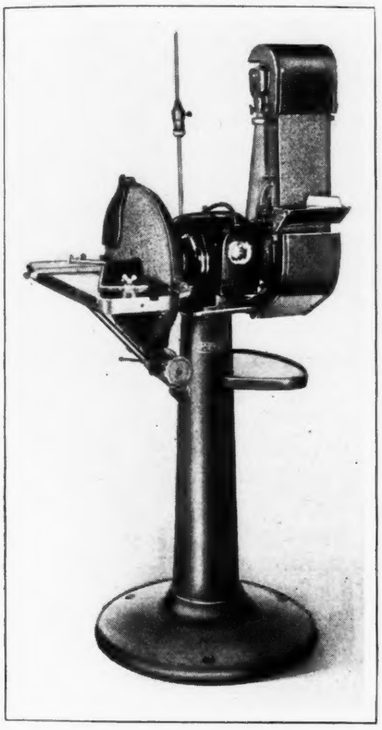
PORTER-CABLE BELT AND DISK GRINDER AND SANDER

A combination belt and disk grinder and sander, designed to permit rough- and finish-grinding of work at the same time has recently been developed by the Porter-Cable Machine Co., N. Salina and Exchange Sts., Syracuse, N. Y. Two men can work on the machine at one time or one man can handle certain jobs on both the belt and disk at once.

The table on the disk side of the machine may be tilted up and down through a range of 55 degrees or removed in order to permit the use of the

entire disk face. The angle gage and a core-print gage which operate in a slot of this table make it possible to grind to compound angles and to a variety of curves. A patented vacuum dust-collecting system is built into the machine. This system consists mainly of fans at the back of the disk which produce a vacuum in the housing and thus draw and force the dust through the pedestal to the floor.

A 3/4-horsepower ball-bearing equipped motor furnishes power to operate both the disk and the belt. The belt side of the machine is also equipped with a table and an angle gage which may be readily removed or tilted up and down. When the table and upper dust guard are removed, pieces 18 inches in length or longer may be uniformly sanded by moving them back and forth along the belt.



Porter-Cable Combined Belt and Disk Grinder and Sander

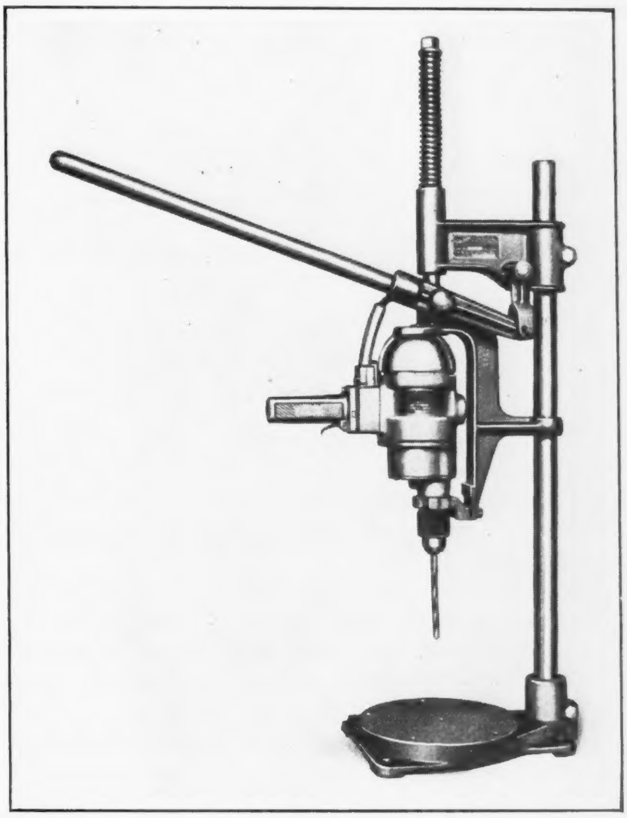
The bed under the belt may be placed in either a horizontal or a vertical position by merely removing four cap-screws. This makes the machine convenient for various operations and provides three machines in one. The weight of the machine is approximately 300 pounds. The disk is 15 inches in diameter and is run at a speed of 1725 revolutions per minute. The abrasive belt is 6 inches wide by 54 1/2 inches long, and runs at a speed of 3300 feet per minute.

STERLING GRINDING DISK

Grinding disks consisting of full-dimension wheels held by sulphur to a steel plate are now made by the Sterling Grinding Wheel Co. Abrasive Division of the Cleveland Stone Co., Tiffin, Ohio. Formerly, the disks consisted of a thin paper disk glued to the steel plate. The new disk, being thicker, lasts much longer, and when worn out, can be replaced in from fifteen to twenty minutes. Delay in cleaning the plate is eliminated, and as the disk is sulphured, it sets in a few minutes.

VAN DORN BENCH DRILL STAND

The Van Dorn Electric Tool Co., Cleveland, Ohio, now makes a stand intended for converting the 1/2-, 5/8-, and 7/8-inch portable electric drills manufactured by that company into efficient bench drilling machines. The drill is held rigidly to the stand by means of two screws entering the top



Bench Stand for Van Dorn Drills

head and two screws entering the clamp bracket. The line of pressure in this stand is directly over the twist drill. A tension spring functions to lift the drill out of the work instantly when the operating handle is released. The weight of this stand is 56 pounds.

"DUMORE" STEEL CARRYING CASES

Steel carrying cases are now being made by the Wisconsin Electric Co., 25 Sixteenth St., Racine, Wis., for the No. 2-AG grinder and No. 3 multi-speed grinder manufactured by that company. These cases, one of which is shown in the accompanying illustration, facilitate the handling of the grinders, as an entire equipment can be conveniently kept in the case provided for it. There is little

Steel Carrying Case for "Dumore" Grinder

chance for any of the parts to be mislaid or to become separated from the tool. The handles make it an easy matter to carry the boxes from place to place, and add materially to the portability of the grinders.

CENTERLESS-FEED POLISHING MACHINE

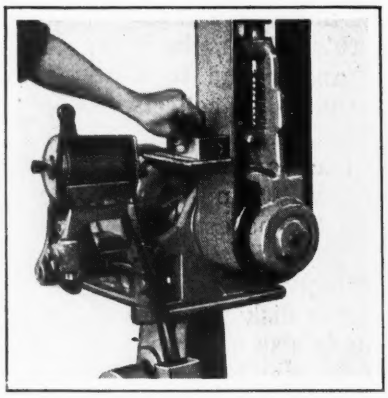


Fig. 2. Centerless Feed Swung Back

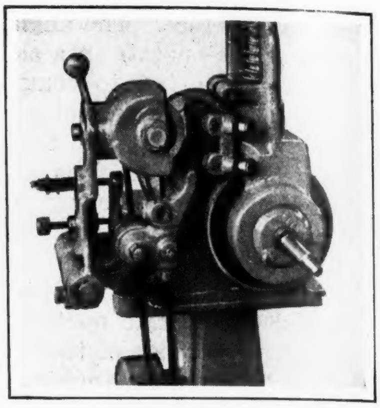


Fig. 3. Taper Spindle in Place for Internal Work

Cylindrical, internal, and flat work can be polished on the type S polishing and finishing machine now being placed on the market by the Production Machine Co., Greenfield, Mass. This machine may be used with the belt unit horizontal or vertical. Various metals, fiber, rubber, wood, glass, and other materials can be polished.

Various lengths of cylindrical work may be fed automatically through the machine by means of the centerless-feed attachment. When it is desired to finish articles having round shanks, such as screwdrivers, taps, and bolts, the work is fed to a stop, only the portion that is to be finished being presented to the abrasive belt. Very small and short articles, cylindrical in form, may be fed automatically by means of hopper fixtures which are easily applied.

Cylindrical work is usually supported on a fiber rest. A double-roller platen is located in back of the belt where the finishing is to be done. Varying pressures as well as varying rates of feed are quickly and easily obtainable by adjusting this feed-roll unit. When the centerless feed is not required, the entire unit may be swung out of the way by releasing one screw. Ample provision is made for all feed-roll adjustment. The drive for the power feed-roll is taken from the motor shaft and reduced by means of worms and gears.

Flat and irregular shapes may be finished by hand either on the table or on the unsupported part of the belt where the belt will conform to irregular shapes. When finishing such work, the centerless feed attachment is swung out of the way and the flat platen or table placed behind the belt. The table may be used in either the vertical or the horizontal position, as shown in Fig. 2 and at the left in Fig. 1, respectively.

The finishing belt may be an abrasive, canvas, or felt belt, depending upon whether coarse or fine finishing, buffing, or coloring is to be done. The abrasive belt is made endless with a patented interlocking joint that gives practically the same thickness at the joint as elsewhere, resulting in a smooth running belt. The belt is kept at the proper tension by means of a spring which is applied to the shaft of the idler pulley.

A feature of the machine is the taper spindle provided for finishing internal work. This spindle may be clearly seen in Fig. 3. It will receive small wheels suitable for most classes of internal polishing or cleaning. The machine can be furnished either with or without a base. The abrasive belt is 4 inches wide by 60 inches long, and runs at a speed of 3200 feet per minute.

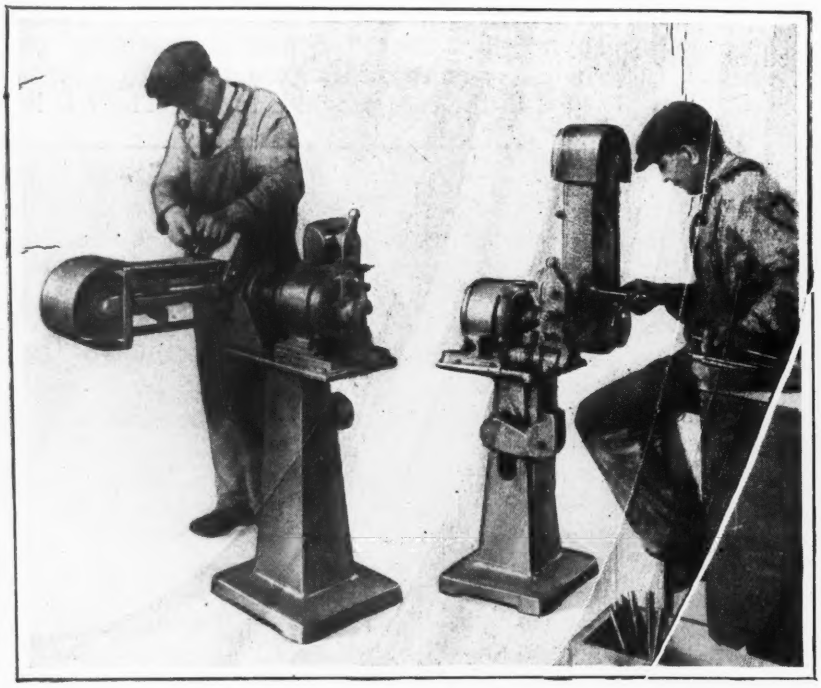


Fig. 1. Using the Production Type S Polishing Machine for Flat and Cylindrical Work

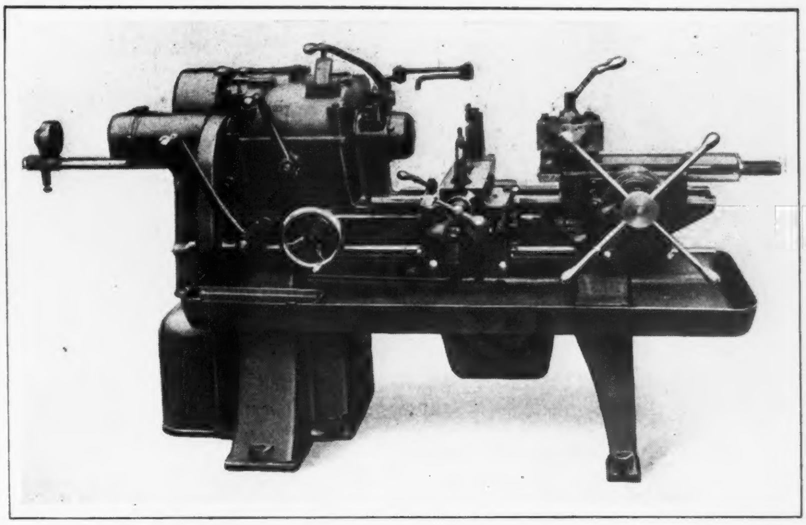
WARNER & SWASEY TURRET LATHE

A new No. 4 turret lathe which may be equipped with a six-speed all-geared head, a six-speed cone head or a twelve-speed all-geared head, is being placed on the market by the Warner & Swasey Co., Cleveland, Ohio. This machine has a bar capacity of 1 1/2 by 10 inches, and will swing chucking work up to 8 inches in diameter.

Either a power-feed cross-slide or a plain screw-feed cross-slide can be furnished. With the power-feed cross-slide, six feeds are obtainable through levers mounted on the carriage apron within convenient reach of the operator. Longitudinal feed is accomplished through a handwheel mounted on the front of the machine near the head end. A round toolpost is provided on the front of the cross-slide carriage, and a holder for a cut-

ting-off tool on the rear of the carriage.

The plain screw-feed cross-slide is hand-operated. The longitudinal feed is obtained through a handwheel mounted on the front of the turret lathe near the head end, and the cross-feed, through a handwheel on the front of the screw-feed carriage. The toolpost equipment is the same as that furnished on the power-feed cross-slide.



Warner & Swasey No. 4 Turret Lathe

CINCINNATI PLANERS WITH DUO-CONTROL

Large-sized planers built by the Cincinnati Planer Co., Cincinnati, Ohio, are now arranged for operation from both the right- and left-hand sides. The down slides on the rail-heads of these machines are independent of each other and eliminate the sliding of gears and clutches in back of the saddle. With this new design, the gears are always in engagement. This requires two feed-rods for the rail, which makes it possible to feed one slide while rapidly traversing the other slide.

From the illustration it will be noticed that the levers on the right-hand side of the rail are duplicated on the left-hand side. This means that it is possible to engage the rapid traverse or the feed to raise or lower the rail and to loosen or clamp the rail from the left-hand side of the planer as well as from the right-hand side. It is pointed out that on large machines there is quite an advantage in the possibility of operating the machine from either side. When there are two operators on a machine, one man can control the left-hand head from the left-hand side without requiring the assistance of the operator on the right-hand side. This naturally reduces the set-up time and the time lost between cuts. When there is only one operator and he happens to be on the left-hand side of the planer, he can operate the rail and heads without walking around the machine.

Another improvement consists of a support which has been embodied in the harp. A curved surface is cast on top of the saddle, and the harp is held to this surface by means of a clamp. This construction assists considerably when reaching down below the bottom of the rail with the slide. In the old construction, the harp was bolted to the saddle by four bolts located close to the center and thus giving a very small leverage. With the additional clamp on top of the saddle, the leverage has been increased, and thus the harp is held securely to the saddle.

Cincinnati Planer Rail with Control Levers on Both Ends

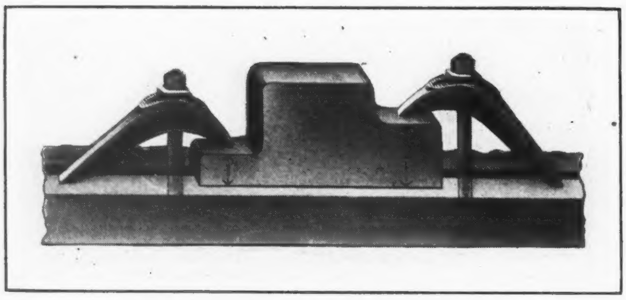
GENERAL ELECTRIC WELDING ELECTRODE

A welding electrode that combines the characteristics of a fluxed electrode, the quality of bead finish and the cleanliness in handling of bare welding electrode has been introduced to the trade by the Merchandise Department of the General Electric Co., Bridgeport, Conn. This electrode is recommended for use in the general welding of steel having a uniform flowing quality. Absence of the sputtering or spattering characteristic of the usual commercial bare welding wire is one of the features claimed for the new material.

The elimination of the erratic arc condition leads to a deposit of more material with the same consumption of electrode per kilowatt-hour. This electrode has been termed "GE Type F" and is furnished in 3/32-, 1/8-, 5/32-, 3/16-, and 1/4-inch sizes. The standard package weighs 50 pounds. It is also furnished on steel reels weighing approximately 200 pounds or in coils weighing 150 or 200 pounds.

BILLINGS ADJUSTABLE STRAP CLAMP

An adjustable strap clamp designed for holding work on the faceplate of lathes and on the table of planers, boring mills, drilling machines, and milling machines has just been placed on the market by the Billings & Spencer Co., Hartford, Conn. The design of this clamp permits it to be used on irregular shapes and various sizes of work without the



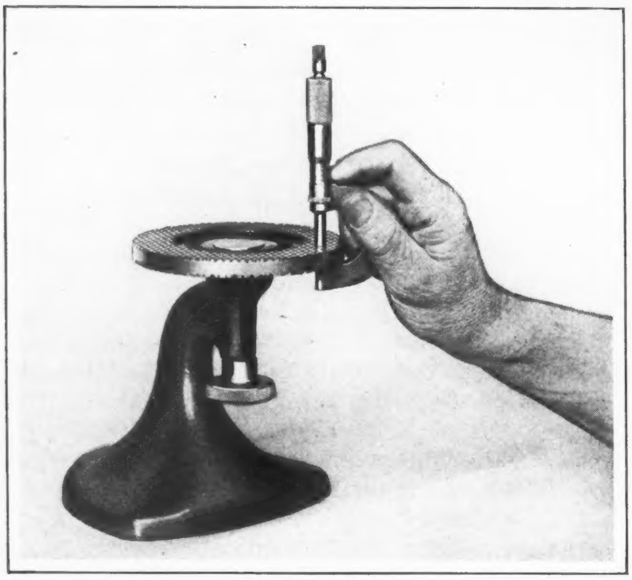
Method of Using Billings Strap Clamps

necessity of blocks or shims, and it eliminates the time frequently lost looking for washers, etc.

When the work to be strapped is larger than the capacity of the clamp, a block not greater in height than the work should be used, it being unnecessary to use blocking of a definite height. The clamp has but two working parts. It is made in three sizes, and is hardened in oil.

BETHEL-PLAYER BENCH LAPS

Standard bench laps are being manufactured by the Bethel-Player Co., Westboro, Mass., which enable toolmakers and machinists to conveniently



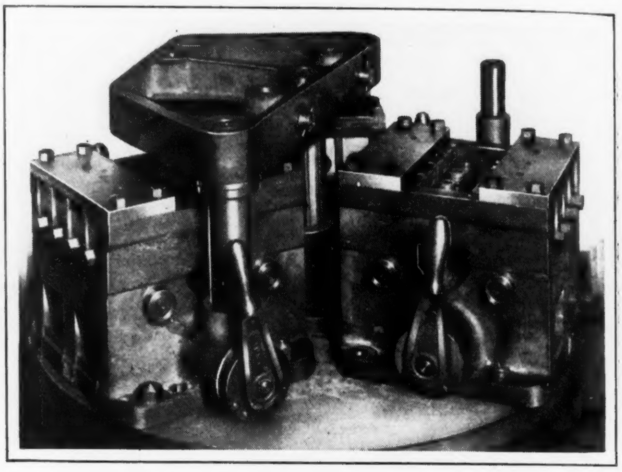
Bethel-Player Bench Lap for Toolmakers and Machinists

correct errors due to wear in micrometers, snap and limit gages, end rods, gage-blocks, parallels, etc. With this device and inexpensive holders, angular surfaces such as found on cutting tools for thread gages, and other accurate forms, may be kept flat and at the correct angle with a high degree of polish.

The device consists of a cast-iron base and a series of circular lap plates of various thicknesses. These plates are serrated and lap-finished on both sides parallel within 0.0001 inch. Four laps, 4 1/2 inches in diameter and 3/8, 1/2, 3/4, and 1 inch in thickness, respectively, are provided as standard. This set gives ten different built-up lapping thicknesses for large gap gages, etc. Lap plates 6, 9, 12, and 18 inches in diameter can also be furnished. Worn laps can be returned to the manufacturer for relapping.

QUICK-CLAMP LOCK FOR JIGS AND FIXTURES

The quick-clamp lock incorporated in standard jigs, fixtures, and vises sold by the Universal Standard Sales Co., 7 E. Grand Ave., Detroit, Mich., may now be obtained separately for use by customers in devices of special design. Two fixtures to which this lock has been applied may be clearly seen in the illustration. The feature of the lock is that only a single short movement of the handle suffices to lock the part firmly, eliminating the



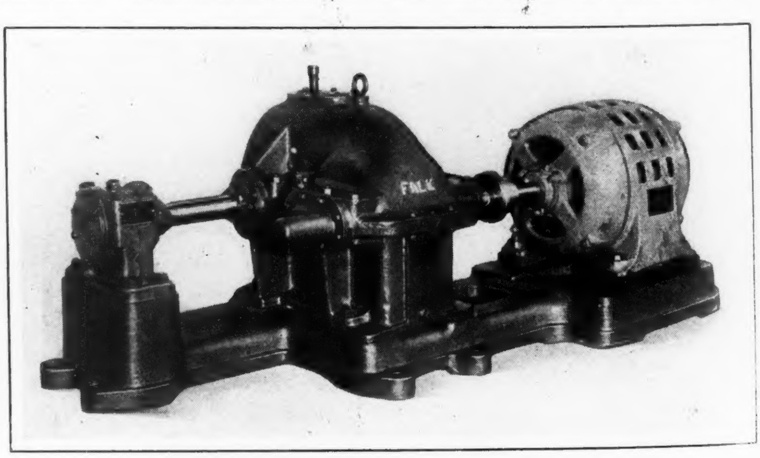
Fixtures Equipped with the Quick-clamp Lock

necessity of turning nuts, star-wheels, handwheels, screws, etc. By imparting an upward movement to the handle, the part is unlocked.

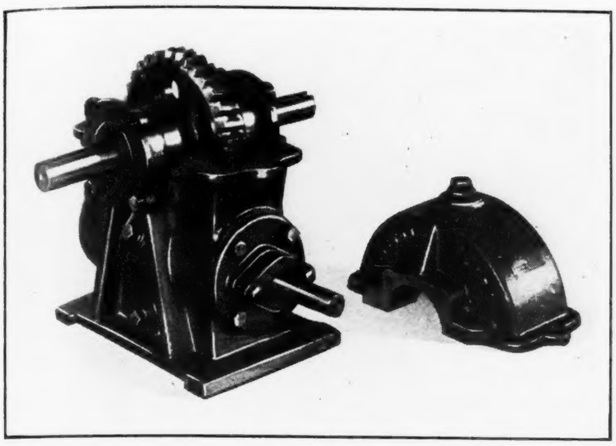
FALK SPEED REDUCERS

A new line of speed reducers embodying all-steel herringbone gears has been brought out by the Falk Corporation, Milwaukee, Wis. The housing of these reducers is of a special design in which there are no internal ribs, projections, or complicated cores. Lubrication is simplified by this design, and it is pointed out that there is no possibility of dirt or core sand working into the gears. Among other features are the airplane-type steel-backed babbitt-lined bearings and an automatic continuous lubrication system.

The reducers are made in three types, with a single reduction for ratios up to 9 to 1; with a double reduction for ratios up to 70 to 1; and with a triple reduction for ratios up to 300 to 1. A double-reduction unit is shown in the illustration.



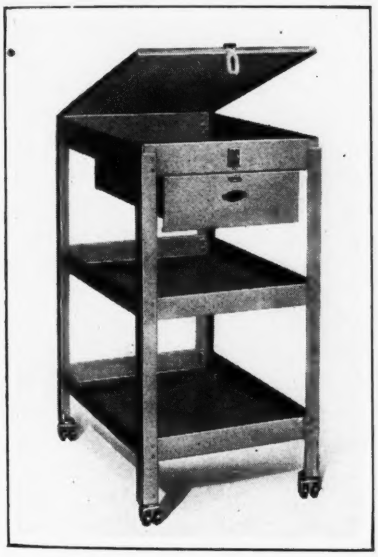
Falk Herringbone-gear Reduction Unit



Boston Speed Reducer with Timken Tapered Roller Bearings

SPEED REDUCERS WITH TIMKEN ROLLER BEARINGS

A complete series of standard worm-gear speed reducers fitted throughout with Timken tapered roller bearings has been brought out by the Boston Gear Works Sales Co., Norfolk Downs, Mass. The claims made for the use of Timken bearings are quiet operation and long life under all sorts of industrial conditions.



Pollard "Tool Tender"

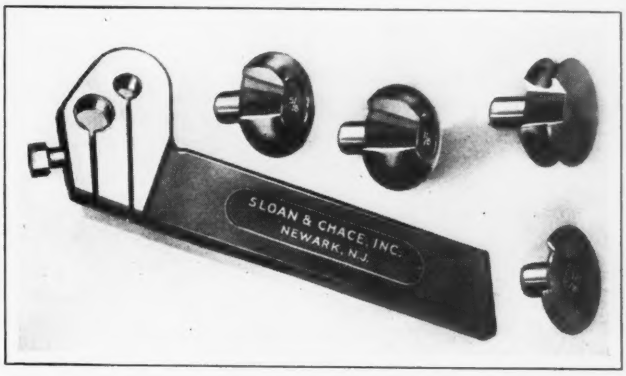
These reducers are regularly built in various ratios up to 50 to 1, and with output ratings of from 1/6 to 8 horsepower, with the driving shaft running at from 900 to 1800 revolutions per minute. The weights range from 30 to 270 pounds.

POLLARD PORTABLE TOOL STAND

A stand termed "Tool Tender" has recently been added to the line of factory equipment made by the Pollard Bros. Mfg. Co., Inc., 4035 N. Tripp Ave., Chicago, Ill. This stand is similar to the one that has been made by the same concern for several years, with the exception that the top pan is deeper and is provided with a cover. The cover is made of heavy sheet steel, and is flanged on all sides to increase its strength. The cover will carry a heavy load without bending, and is fastened to the pan by means of strap hinges. It is also provided with a hasp, so that tools or parts can be locked up. The equipment is particularly recommended for use in garage repair departments and in factories where a man moves from point to point and must take tools, repair parts, etc., with him.

STANDARD-RADIUS LATHE AND PLANER TOOL

Corners, fillets, grooves, and other concave or convex surfaces can be cut to standard radii by means of a tool recently brought out by Sloan & Chace, Inc., 351-5 Sixth Ave., Newark, N. J. The tool is intended for use primarily on lathes, planers, and shapers. It comprises a patented spring holder, a wrench, and a set of cutters ground to standard radii. To cut a fillet to a radius of 1/4 inch, for instance, it is only necessary to clamp a



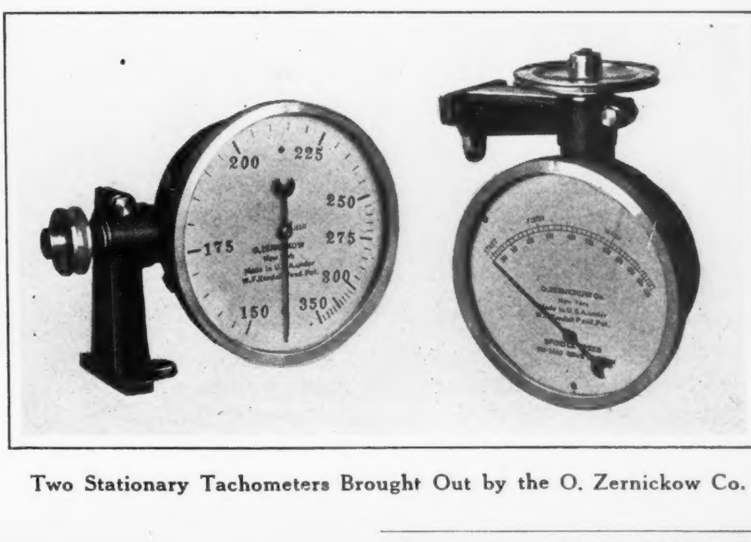
Tool-holder and Interchangeable Cutters Made by Sloan & Chace, Inc.

1/4-inch cutter in the holder. These cutters are readily interchangeable. The holder measures 1/2 by 1 1/8 by 6 3/4 inches.

It is a simple matter to regrind the cutters as they become worn. They are ground to make the cutting face intersect the axis. As the cutters can be used until almost their entire periphery has been ground away, they are long-lived. In addition to standard-radius cutters, each set includes a 60-degree cutter for U. S. standard threads and also a cutting-off tool. Special holders and cutters can be manufactured to meet individual needs.

"O-Z" STATIONARY TACHOMETERS

Two stationary tachometers recently placed on the market by the O. Zernickow Co., 15 Park Row, New York City, are shown in the accompanying illustration. Both models have a dial 6 inches in diameter, an aluminum housing 2 3/4 inches deep, and, with the bracket, weigh about 2 3/4 pounds. They are intended to be mounted on machinery such as turbines. The manufacturer recommends



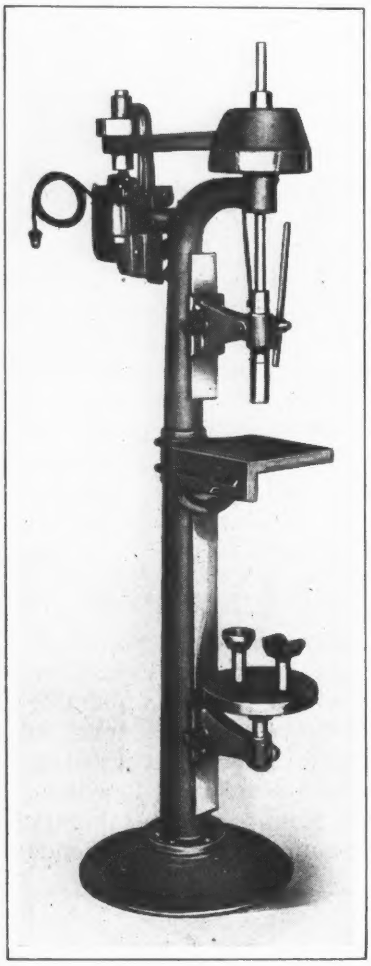
Two Stationary Tachometers Brought Out by the O. Zernickow Co.

that the devices be driven by means of a spring belt, but other methods may be employed, as, for instance, a direct-connected or flexible-shaft drive.

Model A, which is shown at the left, has the hand mounted at the center, and is provided with graduations extending around the entire dial. It is designed for use under normal conditions where a long open scale is desired. Model B at the right, has the hand mounted below the center and is provided with graduations arranged around a semicircle. This type is especially made to stand rough usage, and is adapted for installations where violent fluctuations, sudden starts, and sudden stops are encountered.

CANEDY-OTTO SENSITIVE DRILLING MACHINE

A 14-inch motor-driven sliding-head sensitive drilling machine recently brought out by the Canedy-Otto Mfg. Co., Chicago Heights, Ill., is shown in the accompanying illustration. This machine is constructed for drilling holes up to 1/2 inch in diameter. It is equipped with a toggle switch and cord for receiving power from a lamp socket. Convenient belt tightening is provided for by means of the sliding member to which the motor is attached. This unit can be moved in and out to give the desired tension to the belt. It is securely locked in place by means of a screw.

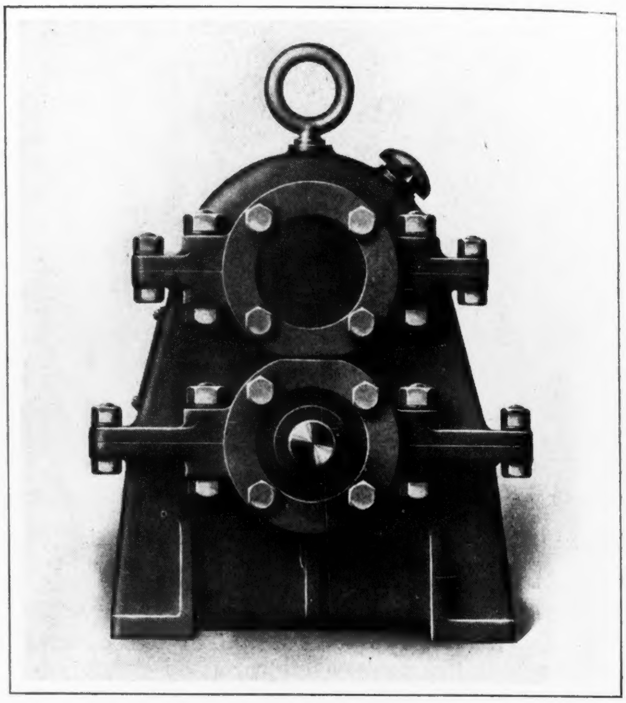


Canedy-Otto Sensitive Drill

The square table, with the slotted apron, can be swung around the column and tilted to any desired angle, while the round table can be lowered or raised to any height and securely clamped. The round table can be removed to permit the use of a cupped center or a V-block, which are furnished with the machine. The net weight of this machine is about 275 pounds, including the motor.

NUTTALL HELICAL-GEAR SPEED REDUCERS

A complete new line of speed reducers embodying 7 1/2-degree helical gears and Timken tapered roller bearings in their design has recently been placed on the market by the R. D. Nuttall Co., Pittsburg, Pa. This SVR series covers a range of



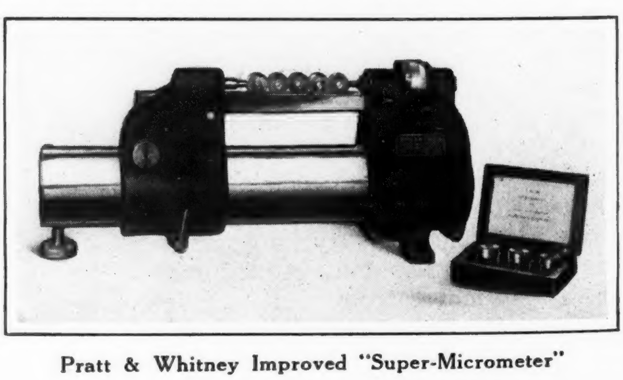
Nuttall Speed Reducer with Helical Gears and Tapered Roller Bearings

from 1 to 150 horsepower and comprises single reduction units with ratios ranging from 1 to 1 up to 8 to 1. The high- and low-speed shafts are parallel and offset in the same plane. Advantages cited for the use of helical gears include smoothness, strength, and high efficiency of the drive. Another advantage claimed is the ability of helical gears to resist external thrust. The tapered roller bearings hold the shafts in positive alignment, and they may be readily adjusted for wear.

The shafts in these reducers are regularly carbon-steel forgings with the pinions integral, but in installations where the load requires, shafts and pinions are made of alloy steel. A positive system of splash lubrication insures a good supply of lubricant to all bearings and a protective oil film on the gear teeth at all times. Oil from the reservoir in the back of the case is picked up by the gear teeth and thrown by centrifugal force into oil troughs which lead it to the bearings. Return ducts drain the oil back into the case and thus prevent leakage around the shafts. There is a chamber in the bottom of the case in which sediment settles.

PRATT & WHITNEY "SUPER-MICROMETER"

A number of improvements have been incorporated in the "Super-Micrometer" manufactured by the Pratt & Whitney Co., Hartford, Conn., since



Pratt & Whitney Improved "Super-Micrometer"

the original model was described in September, 1922, MACHINERY. This device measures work to within 0.0001 inch. The head of the new model, which is known as "Series B," has been redesigned, as shown in the illustration, so as to enclose the moving parts. This construction practically eliminates the excessive wear that followed the accumulation of room dust and abrasives on the formerly exposed parts.

The tailstock has been made stiffer and heavier and, to an even greater degree than in the old model, the feel of the anvils and work coming into contact is unmistakable. The bar or support in which the standard disks are placed when setting the machine, is now left soft instead of being hardened. This improvement removes a possible cause of damage to the standards through accident or carelessness.

The graduations on the dial and vernier are about one-tenth inch apart instead of one-fiftieth inch as formerly. The calibration or reading remains the same, being 0.0001 inch per graduation. The dial is approximately one-half the size of that provided on the previous "Super-Micrometer," it having been found that many operators used the large graduated dial to operate the device, to the total neglect of the smaller knurled wheels. This practice resulted in tarnished dials and undependable readings, and defeated the purpose of the design. In the new model, the graduated dial is provided with a small knurled portion which serves as a finger-hold and obviates the necessity of touching the graduated portion. The vernier scale has an adjustment for bringing the zero lines into agreement. This adjustment is operated through a thumb-screw which is directly connected with the vernier.

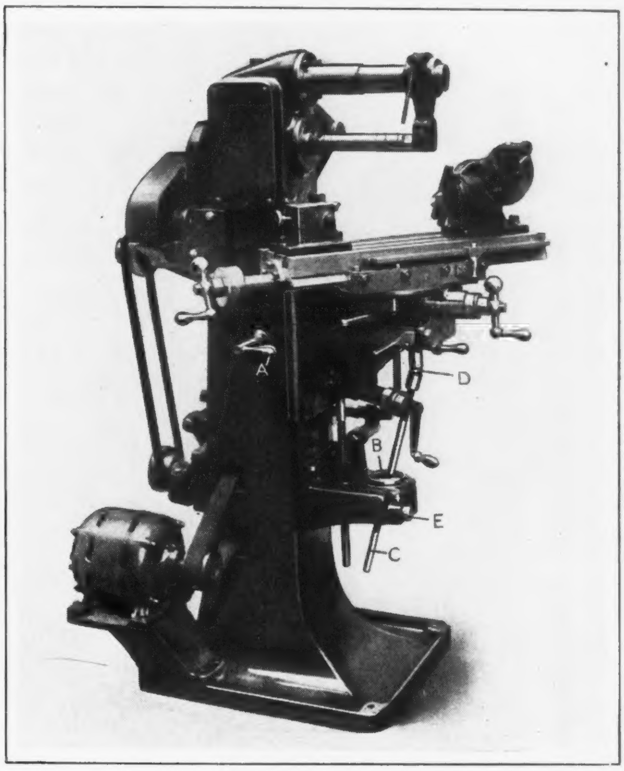
The eight standards that are supplied with the device are now furnished in a box that can be kept in the tool-crib or in the foreman's desk. This prevents them from being lost which occasionally occurred with the old method of storing the standards on a pin attached to the machine. The new method also eliminates abrasion of the finished standard faces when removing or replacing the cover which was provided to protect them from dust. The "Super-Micrometer" has a range of 8 inches between the anvils. It is intended to be used as a shop tool and not merely as a laboratory instrument.

ARTISAN UNIVERSAL MILLING MACHINE

A small universal milling machine having a table travel of 14 inches, a cross travel of 5 inches, and a knee elevation of 11 inches has recently been placed on the market by the Artisan Mfg. Co., 865 Hathaway St., Cincinnati, Ohio. This machine has a self-contained countershaft on the right-hand side, and is provided with a single friction-clutch pulley that also serves as a brake.

When the machine is belt driven, power is transmitted direct to the friction-clutch pulley from a driving pulley on the lineshaft. When motor-driven, a 1/2-horsepower motor is mounted on a bracket bolted to the column base and the driving belt passes through openings in the column to the friction-clutch pulley. Handle *A* controls the friction clutch and brake. A three-step cone pulley attached to the countershaft transmits power to another cone pulley on a jack-shaft, which rotates more than twice as fast as the spindle at all times. The jack-shaft speed produces a high spindle driving belt velocity. A sliding back-gear provides six spindle speeds ranging from 21 to 500 revolutions per minute.

A gear on the rear end of the spindle furnishes power for feeding the table in either direction. Six feeds ranging from 0.00075 to 0.024 inch per spindle revolution are obtainable. The feed belt drives a lower feed cone pulley, which drives shaft *E*. This shaft passes through the column and carries a steel worm which engages worm-wheel *B*. Feed-shaft *C* is universally driven by the worm-wheel. The upper half of universal joint *D* is provided with a snap socket so that it can be readily attached for providing either a table- or cross-feed,

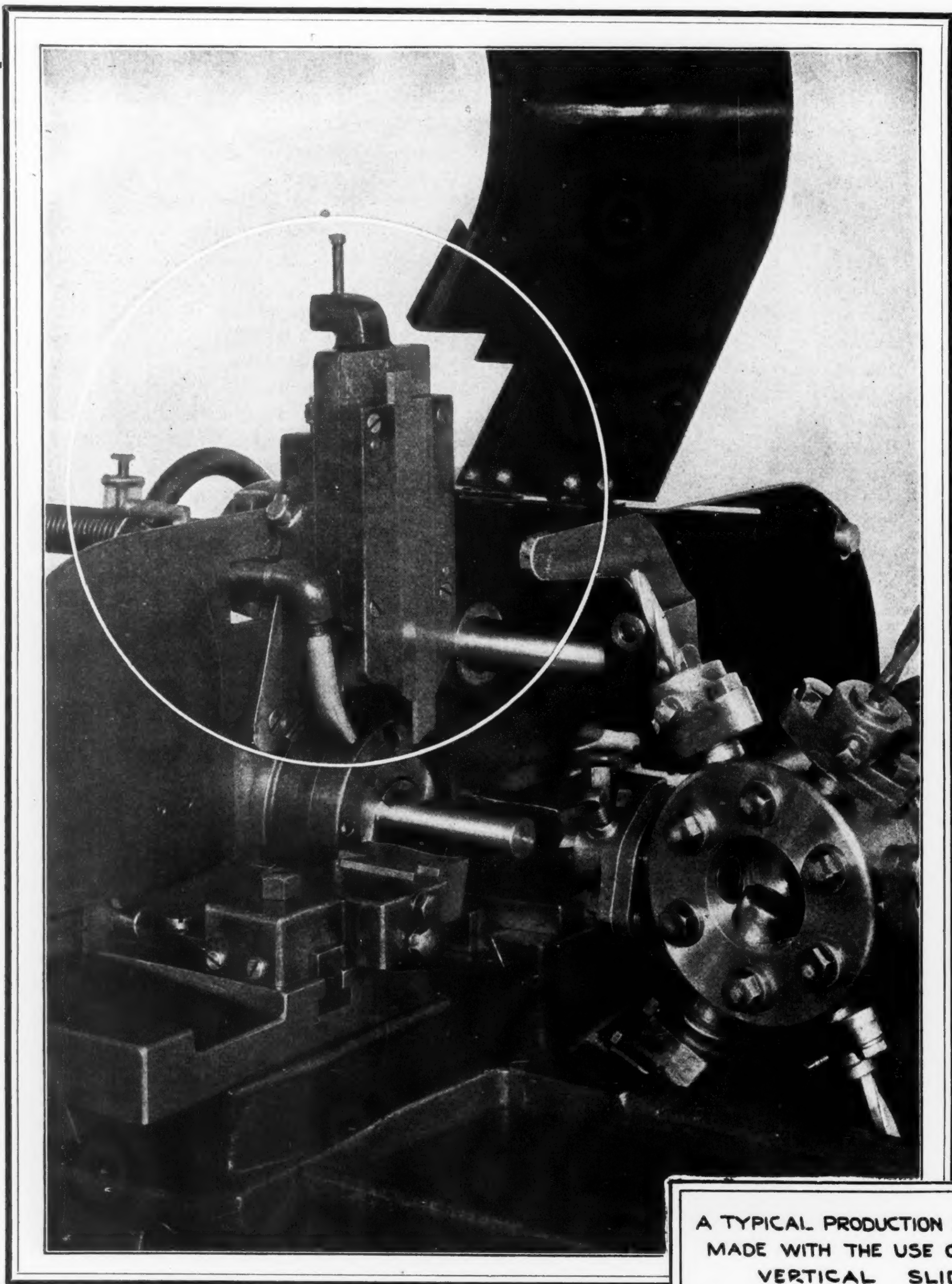


Artisan Universal Milling Machine

the illustration showing the cross-feed in use. The machine, without the motor, weighs about 650 pounds. It is well adapted to both manufacturing and light tool-room work.

ARMSTRONG CHROME-VANADIUM STEEL WRENCHES

A No. 26 set of chrome-vanadium steel wrenches was recently placed on the market by the Armstrong Bros. Tool Co., 313 N. Francisco Ave., Chicago, Ill. This set comprises six wrenches having openings which suit five U. S. standard nuts, eight S.A.E. nuts, and eight hexagonal-head cap-screws. The openings range from 3/8 to 1 inch in width, in increments of 1/16 inch. The wrenches are drop-forged, heat-treated and finished in nickel over copper. Thin deep-set jaws enable the user to readily get at nuts located in close quarters.



A disk cam laid out for the particular job, and mounted on the left end of the machine camshaft actuates the slide by means of levers and a rack and pinion.

A TYPICAL PRODUCTION INCREASE MADE WITH THE USE OF THE VERTICAL SLIDE

3/16" C. R. STEEL

WITHOUT VERTICAL SLIDE
TIME: 13 SECONDS

USING VERTICAL SLIDE
FOR CUTTING OFF
TIME: 9 SECONDS

OBITUARIES

JUSTUS H. SCHWACKE

Justus H. Schwacke, former president of William Sellers & Co., Inc., Philadelphia, Pa., died February 17, at Boca Grande, Fla., at the age of seventy-nine. Mr. Schwacke had been continually with William Sellers & Co. from July 15, 1862 until May 31, 1926, when he retired. He was elected secretary of the company when it was incorporated in 1886, and was made a director in 1902, manager in 1905, and president in 1922. His extraordinarily long service, covering a period of sixty-four years, was marked by great devotion to the interests of the company and efficiency in the performance of his duties. His passing is deplored by all who were associated with him.

Justus H. Schwacke

He had been active in the National Metal Trades Association since its formation and was its president during the administrative year 1910-1911. He was also an honorary member of the Administrative Council of the association. He has also been active in the National Founders' Association and the Metal Manufacturers' Association of Philadelphia since their formation, and he was for several years president of the latter association, of which he was also recently made an honorary member. He was a member of the Machinery Club of the city of New York and of the Art Club of Philadelphia.

JOSEPH HORNER

Joseph Horner, in years past a frequent contributor to MACHINERY, died at Bath, England, February 9, at the age of eighty. Mr. Horner was born at Bristol, England, in 1847. His early technical training was acquired by serving an apprenticeship of seven years with Stothert & Pitt, Ltd., Bath, England, and by attending technical evening classes. After having finished his apprenticeship, he remained in the employ of Stothert & Pitt, where he worked for considerably more than thirty years—fifteen years as foreman. His training here was very broad, because the works handled at that time a great variety of machinery and products, and his duties as foreman kept him in close touch with all branches of mechanical work. Later in life he devoted himself wholly to technical writing, and he contributed to a number of engineering and technical publications, which, besides MACHINERY, included *Engineering*, the *Mechanical World*, the *American Machinist*, *Foundry*, and *Cassier's Magazine*. He is the author of a number of books, among which may be mentioned "Patternmaking," "Practical Iron Founding," "Toothed Gearing," "Helical Gears," "Dictionary of Engineering Terms," "Hoisting Machinery," "Milling Machines," and "Practical Metal Turning." Besides his knowledge of mechanical subjects, he was well versed in general literature and poetry; for many years he studied the practical application of microscopy, and lately astronomy.

CHARLES C. STUTZ, since 1920 secretary of the American Institute of Weights and Measures, died recently at his home in New York City. Mr. Stutz was born in Naples, Italy, in 1861, and received his engineering education in Switzerland. In 1888 he entered the employ of the Brown & Sharpe Mfg. Co., Providence, R. I., where he soon became assistant chief draftsman. Later he returned to Europe, but came again to America and was employed in various engineering capacities with the Sprague Electric Co. and the Pittsburg Plate Glass Co. He was a member of the American Society of Mechanical Engineers and of the American Institute of Electrical Engineers.

CHARLES M. BROWN

Charles M. Brown, president and chairman of the board of directors of the Colonial Steel Co., Pittsburg, Pa., died in the West Penn Hospital, Pittsburg, March 9, following a brief illness. Mr. Brown was born in Pittsburg fifty-six years ago. He was educated at the Shady Side Academy, from which he graduated in 1887, and at Yale University, graduating in 1891. He then entered the employ of the Howe-Brown Steel Co., with which company he remained until 1900 when the Crucible Steel Co. was formed, absorbing the Howe-Brown Steel Co. In 1903 he became associated with the Colonial Steel Co., with which company he successively held the offices of secretary, treasurer, vice-president in charge of sales, and for the last four years president, in which position he was serving at the time of his death. He was also a trustee of the Dollar Savings and Trust Company, Pittsburg, Pa.

Charles M. Brown

PERSONALS

E. W. BUSCHMAN resigned as general sales manager of the Foster Machine Co., Elkhart, Ind., on March 1.

H. A. MOORE, formerly sales manager of the High Speed Hammer Co., Rochester, N. Y., is now general sales manager of the Foster Machine Co., Elkhart, Ind.

FRANK J. DONNELLY has joined the New York office of the Botfield Refractories Co., Philadelphia, Pa., manufacturer of "Adamant" firebrick cement, and will cover the New Jersey territory.

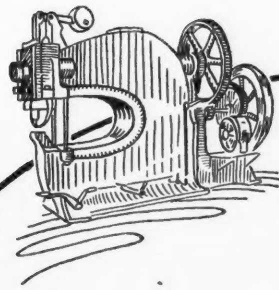
W. L. DIXON, formerly superintendent and production engineer of the Mack Trucks, Inc., New Brunswick, N. J., is now connected with the sales department of the Bullard Machine Tool Co. of Bridgeport, Conn.

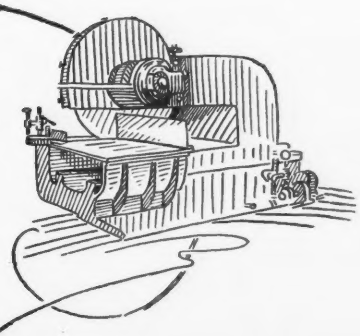
J. S. HOFFMAN, formerly sales engineer for the Detroit Machine Tool Co., is now associated with the Foster Machine Co., Elkhart, Ind., in the capacity of sales engineer, working in connection with the company's agent, the Strong, Carlisle & Hammond Co., in the Detroit district.

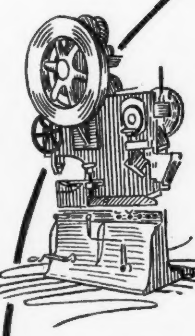
JOSEPH J. BRAUN, formerly president and general manager of the Accurate Gear Corporation, Brooklyn, N. Y., has taken up his new duties as chief engineer of the Micarta Fabricators, Inc., 307 Canal St., New York City, and general manager of the Accurate Gear Division of this company.

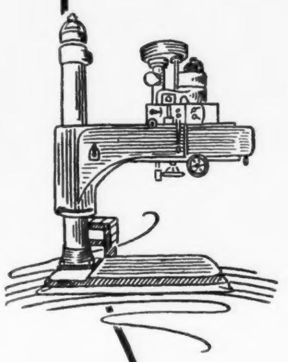
FRED G. BELL has been placed in charge of the motor supply business of the Shepard Electric Crane & Hoist Co., Montour Falls, N. Y., for the purpose of more closely coordinating this new development with the company's electric crane and hoist business. Mr. Bell was formerly president and general manager of the Zobell Electric Motor Corporation, Garwood, N. J.

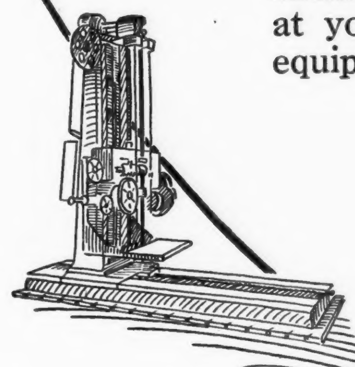
L. C. WILSON has been placed in charge of the sales and engineering service in connection with the distribution of the new Brown electric flow meter in the Pittsburg territory by the Brown Instrument Co., Philadelphia, Pa. Mr. Wilson has received special technical training in fluid flow and measurement at Armour Institute, and has had twelve years of practical experience in the instrument field.

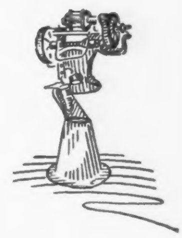


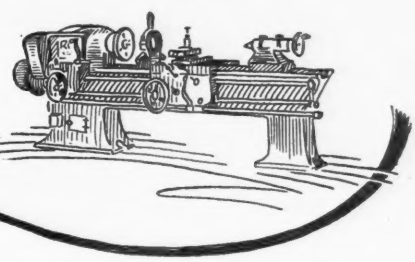












ARTHUR SIMONSON was elected vice-president of the Falk Corporation, Milwaukee, Wis., at the last annual meeting of the board of directors. Mr. Simonson was born in Sheffield, England, and educated in that country. In 1900 he came to the United States as representative of Alexander Tropenas, inventor of the side blow converter, and installed the process in various plants. For some years, he was general foundry superintendent of William Wharton, Jr. & Co., Inc., of Philadelphia, Pa. Since 1910 he has been connected with the Falk Corporation in various capacities in the steel foundry, serving as sales manager of the steel foundry department since 1916.

John F. Barr

JOHN F. BARR has joined the Chain Products Co. of Cleveland, Ohio, as export manager for that company and its associated industries, the Van Dorn Electric Tool Co. and Van Dorn & Dutton Co. Mr. Barr was formerly connected with Sargent & Co., hardware manufacturers, and for two years was stationed in Buenos Aires, South America, for them. He was also connected with the direct factory export representatives, A. H. Keleher, Inc., of New York. During 1925 he represented this company in Brazil.

EUGENE BOUTON, of the Chandler-Cleveland Motors Corporation, is now chairman of the Production Advisory Committee of the Society of Automotive Engineers. E. A. TAYLOR, of the Yellow Sleeve-Valve Engine Works, East Moline, Ill., is vice-chairman. The committee consists of twelve members. The function of the committee is to study the special problems that concern the automotive production engineer.

E. A. FISCHER has been appointed advertising manager of the Kearney & Trecker Corporation, Milwaukee, Wis. Mr. Fischer's mechanical experience was gained in the engineering departments of the Worthington Pump Co. and the Kempsmith Mfg. Co. He has been advertising manager for C. Niss & Sons Co., of Milwaukee, and later conducted his own advertising service. Joseph Trecker will continue to serve as assistant advertising manager.

HOWARD E. OBERG, who has been connected with the forging industry for fifteen years, has been placed in charge of sales engineering for the complete machinery line of the Billings & Spencer Co., Hartford, Conn., manufacturer of the "Triangle B" line of drop-forged tools, special forgings, and forging machines. Mr. Oberg's territory will embrace the Middle West, and his headquarters will be in Detroit, Mich., in the General Motors Building, Room 5-251.

EDWARD A. MULLER, president of the King Machine Tool Co., Cincinnati, Ohio, has been re-elected president of the Cincinnati branch of the National Metal Trades Association for the third consecutive year. Other officers who will serve during the coming year are: A. B. BREEZE of the Cincinnati Ball Crank Co. who is vice-president; H. A. FELDBUSH of the Worthington Pump & Machinery Corporation, secretary; and J. E. MILLS of the Smith & Mills Co., treasurer.

JOSEPH G. WORKER has been appointed general sales manager and a member of the board of directors of the American Engineering Co., Philadelphia, Pa. Mr. Worker assumes his new duties with more than twenty years' experience in engineering and sales work, the last five of which he has served as assistant to the president of the American Engineering Co. For fifteen years previously, Mr. Worker was associated with the Westinghouse companies, having been manager of the stoker section of the Westinghouse Electric & Mfg. Co., at East Pittsburg, Pa., for five years.

Colonel CHARLES CLIFTON has resigned from the presidency of the National Automobile Chamber of Commerce, a position which he has held since the beginning of association work in the industry nearly twenty-five years ago. The directors elected Colonel Clifton honorary president and honorary director. ROY D. CHAPIN, chairman of the board of the Hudson Motor Car Co., becomes the new president; ALVAN MACAULEY, president of the Packard Motor Car Co., was elected first vice-president; and ALFRED H. SWAYNE, vice-president of the General Motors Corporation, was elected vice-president of the passenger car division.

* * *

TRADE NOTES

M. A. WERTMAN MACHINERY CO., dealers in new and used machine tools and hydraulic machinery, has moved into new offices at 429 Penton Bldg., Cleveland, Ohio.

WETMORE REAMER CO., 60 Twenty-seventh St., Milwaukee, Wis., is now represented in the Philadelphia territory by Joseph F. Sample, 23 S. 52nd St., Philadelphia, Pa.

MEDART CO., St. Louis, Mo., manufacturer of power transmission machinery, announces that the company is now prepared to supply a complete line of Timken-equipped spherical ball and socket pillow blocks, ball and socket hanger bearings, and loose pulleys.

HORLDT & BIHLER, Mechanical Engineers, Thompson Bldg., Providence, R. I., has been established by H. M. Horldt and W. G. Bihler, formerly of the Horby Engineering Co., of Hartford, Conn. The new firm will specialize in the design of automatic machinery, dies, jigs, and fixtures.

EARLE GEAR & MACHINE CO., 4707 Stenton Ave., Philadelphia, Pa., has appointed William H. Allen, Room 704, 110 State St., Boston, Mass., New England manager of the company. Mr. Allen will have charge of the sale of Earle cut gears, bridge operating machinery, Lea-Simplex cold-metal saws, and special machinery.

HERMAN MACHINE & TOOL CO., machine-builder, contractor, and specialist in screw machine products, formerly of Akron, Ohio, has moved to Tallmadge, Ohio, where the company has erected a modern fireproof plant. The new plant has a floor space of 42 by 92 feet, and a special shop is provided for doing all classes of heat-treatment.

GOULD & EBERHARDT, Newark, N. J., advises that the company has brought suit for infringement of one of its United States patents applied to gear-hobbing machines, in the United States District Court, Southern District of New York, Eastern Division, against O. Zernickow Co., importers of gear-hobbing machines manufactured in Germany.

LINK-BELT CO., 300 W. Pershing Road, Chicago, Ill., has opened a new branch sales office at 229 Brown-Marx Bldg., Birmingham, Ala. W. H. Norton, for many years connected with the company's Chicago sales department, will assume the managership of the new territory. Harold R. Haught, formerly located at the Indianapolis Dodge plant of the company, will assist Mr. Norton in the sale of silent chains.

SKINNER CHUCK CO., New Britain, Conn., announces that since March 15 the company is represented in New York and surrounding territory by Karl Lehnhardt, with offices at 86 Warren St., New York City. A complete stock of Skinner chucks will be carried in New York, and the factory in New Britain, being within easy reach, will supplement the local New York stock, assuring prompt delivery.

HAROLD E. TRENT CO. has moved to larger quarters at 439-443 N. 12th St., Philadelphia, Pa. It is the intention of the company to develop large size metal pots and pot furnaces for temperatures up to 1700 degrees F., in addition to its standard line of metal melting pots ranging up to 1500 pounds capacity, for temperatures up to 1000 degrees F. This company also manufactures soldering irons, solder troughs, calibration tanks, etc.

GENERAL MACHINERY CORPORATION, 170 Summer St., Boston, Mass., has made arrangements with the following manufacturers to represent the company in the New England states with the exception of Connecticut: Oliver Instrument Co. of Adrian, Mich., will handle automatic drill pointers, point thinning machines, die filing machines, radial profiling machines, inserted-tooth milling cutters, and grinding machines. Schuchardt & Schutte Co., 142 Liberty St., New York City, will handle gear-hobbing machines.

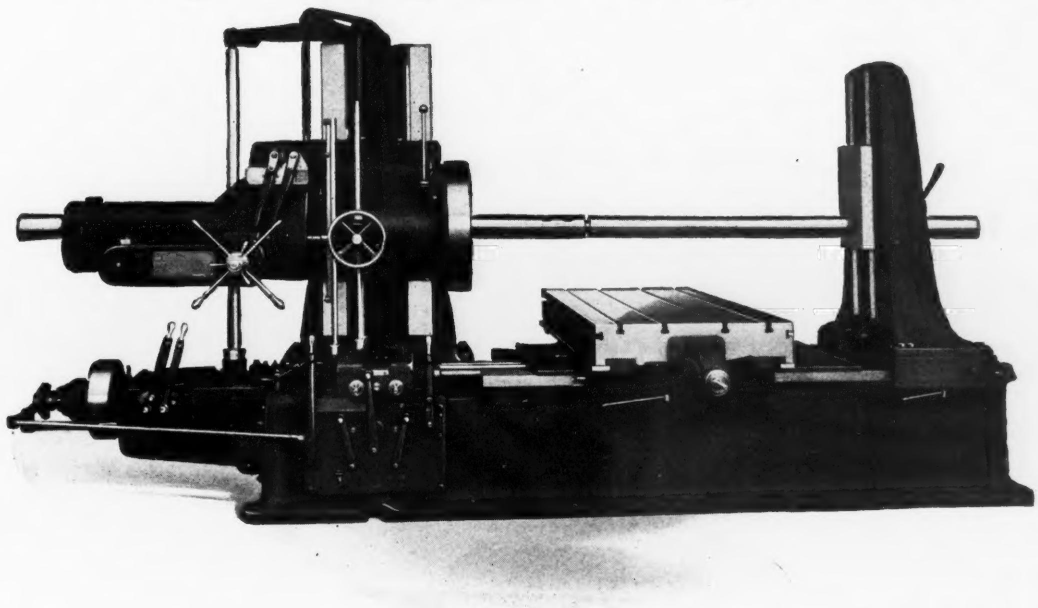
GENERAL ELECTRIC CO., Schenectady, N. Y., has sold the entire Sprague electric hoist and winch business to the Shepard Electric Crane & Hoist Co., Montour Falls, N. Y. The Sprague Electric Hoist Division of the Shepard Electric Crane & Hoist Co., with headquarters at 30 Church St., New York City, has been created to handle exclusively the sale of Sprague hoists and winches. N. A. Hall, for many years associated with the Sprague Electric Works, has been appointed manager of this division.

An Excellent Overflow Machine

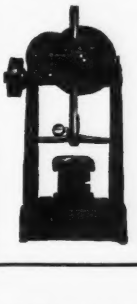
As your boring, milling and drilling departments become crowded, from time to time, take care of the peak load in all of them, successively and successfully with a LUCAS

"PRECISION"

Boring, Drilling and Milling Machine



Holes may be bored and surfaces milled at a single setting and their accurate relation assured, without the necessity of expensive jigs.



WE ALSO MAKE THE
LUCAS POWER
Forcing Press

THE LUCAS MACHINE TOOL CO., Cleveland, Ohio, U. S. A.

FOREIGN AGENTS: Alfred Herbert, Ltd., Coventry, Societe Anonyme Belge, Alfred Herbert, Brussels. Allied Machinery Co., Turin, Barcelona, Zurich. V. Lowener, Copenhagen, Oslo, Stockholm. R. S. Stokvis & Zonen, Paris and Rotterdam. Andrews & George Co., Tokyo. Ing. M. Kocian & G. Nedela, Prague. Schuchardt & Schutte, Berlin.

MUELLER BRASS Co., Port Huron, Mich., announces that Oscar B. Mueller, president of the company, has purchased the controlling interest in it from the Mueller Co. of Decatur, Ill. Mr. Mueller has disposed of his interests in the Mueller Co., of Decatur, and in Mueller, Ltd., of Sarnia, Ontario. Robert and Philip Mueller, of Decatur, Ill., will continue as stockholders and directors of the Mueller Brass Co. The Port Huron plant of the company will start immediately on a two-year expansion program involving an expenditure of over $500,000 for plant extensions and new equipment.


A. R. Stedfast

STEDFAST & ROULSTON, Inc. 156 Oliver St., Boston, Mass., has been formed to take over and continue the business of HILL, CLARKE & CO., INC., of Boston, Mass. The new corporation has the following officers: A. R. Stedfast, president; J. W. Roulston, vice-president; and E. A. Nye, treasurer. A. R. Stedfast and J. W. Roulston are well known in the machinery trade, having been associated with Hill, Clarke & Co. for over forty years. E. A. Nye has been with the same company for fifteen years, having had charge of the financial department. The new firm will continue to specialize in high-grade machine tools, representing in New England a great many of the leading machine tool builders of the country. Mr. Stedfast and Mr. Roulston will continue to handle sales in metropolitan Boston. A. M. Stedfast will cover his present territory in Massachusetts; C. V. Peterson, the southern Massachusetts and Rhode Island territory; J. E. Hall, the Connecticut territory; and R. H. Anderson, Maine, New Hampshire, and Vermont.

WHITING CORPORATION, Harvey, Ill., has made the following changes in its sales organization due to additions of new lines and the acquisition of subsidiary companies: R. H. Bourne, formerly vice-president and sales manager, is now senior vice-president and will devote practically his entire time to the sales of the Grindle Fuel Equipment Co. and the Joseph Harrington Co. N. S. Lawrence, formerly vice-president and assistant sales manager, is now vice-president and sales manager in charge of sales for the lines of the Whiting Corporation and the Swenson Evaporator Co. Mr. Lawrence will be assisted by A. H. McDougall and R. E. Prussing.

FOOTE BROS. GEAR & MACHINE Co., 232-242 N. Curtis St., Chicago, Ill., has made the following additions to its distributing organization: The Interstate Machinery & Supply Co., 1006 Douglas St., Omaha, Neb., will acts as representative for IXL products in Omaha, the eastern half of the state of Nebraska, and the western part of Iowa; W. L. Hutcheson, 201 E. California St., Oklahoma City, Okla., has been appointed agent for Oklahoma City and the northern half of the state of Oklahoma; Nashville Machine & Supply Co., 123 Third Ave., N., Nashville, Tenn., will cover the territory of Nashville and the central part of the state of Tennessee; Hollis & Co., 305 E. Markham St., Little Rock, Ark., will act as distributor for Little Rock and vicinity.

MICARTA FABRICATORS, INC., 307 Canal St., New York City, has taken over the entire business and personnel of the ACCURATE GEAR CORPORATION of 273 Sackett St., Brooklyn, N. Y., and has created a new division of the general sales and engineering departments known as the Accurate Gear Division. Joseph J. Braun has been made chief engineer of the company and general manager of the Accurate Gear Division. The plant of the Accurate Gear Corporation has been moved to 307 Canal St., where the combined companies will have their general offices and plant. Up to the present time the Micarta Fabricators, Inc., have been chiefly engaged in fabricating and selling Micarta to the radio industries. From now on the combined companies will cover the entire radio, gear, mechanical, industrial and insulation fields.

COMING EVENTS

APRIL 4-6—Regional meeting, American Society of Mechanical Engineers in Kansas City, Mo. Calvin W. Rice, secretary, 29 W. 39th St., New York City.

APRIL 25-26—Annual convention of the National Metal Trades Association at Hotel Statler, Detroit, Mich. J. E. Nyhan, secretary, People's Gas Building, Chicago, Ill.

APRIL 27-29—Annual meeting of the American Welding Society at the Engineering Societies Building, 29 W. 39th St., New York City. M. M. Kelly, secretary, 29 W. 39th St., New York City.

MAY 12-14—Eleventh annual meeting of the American Gear Manufacturers' Association at Jackson, Mich.; headquarters, Hayes Hotel. T. W. Owen, secretary, 2443 Prospect Ave., Cleveland, Ohio.

MAY 19-20—Spring sectional meeting of the American Society for Steel Treating in Milwaukee, Wis. W. H. Eisenman, secretary, 4600 Prospect Ave., Cleveland, Ohio.

MAY 21—Fourth annual convention of the National Association of Foremen in Cincinnati, Ohio. The entire day's program will be held on the grounds of the Cincinnati Zoo.

MAY 23-26—Spring meeting of the American Society of Mechanical Engineers at White Sulphur Springs, W. Va., with headquarters at the Greenbrier Hotel. Calvin W. Rice, secretary, 29 W. 39th St., New York City.

MAY 25-27—Annual meeting of the Society of Industrial Engineers at Hotel Stevens, Chicago, Ill. George C. Dent, secretary, 608 S. Dearborn St., Chicago, Ill.

MAY 25-27—National Foreign Trade Council convention at Detroit, Mich. O. K. Davis, secretary, 1 Hanover Square, New York City.

MAY 25-28—Spring meeting of the Society of Automotive Engineers at French Lick Springs, Ind. Coker F. Clarkson, 29 W. 39th St., New York City, secretary.

JUNE 6-8—Annual convention of the American Association of Engineers at Tulsa, Okla. Acting secretary, M. E. McIver, 63 E. Adams St., Chicago, Ill.

JUNE 6-9—Annual convention of the American Foundrymen's Association to be held at Edgewater Beach Hotel, Chicago. No exhibition of equipment will be held this year in conjunction with the convention. C. E. Hoyt, executive secretary, 140 S. Dearborn St., Chicago, Ill.

JUNE 7-9—Annual meeting of the Mechanical Division of the American Railway Association at Windsor Hotel, Montreal, Quebec. There will be no exhibits of railway appliances or machinery this year. V. R. Hawthorne, secretary, 431 S. Dearborn St., Chicago, Ill.

JUNE 13-17—Twenty-second annual convention of the National Supply and Machinery Distributors' Association in conjunction with the Southern Supply and Machinery Dealers' Association and the American Supply and Machinery Manufacturers' Association, on board the Steamship *Noronic*, leaving Detroit June 13 and returning June 17. George A. Fernley, secretary, 505 Arch St., Philadelphia, Pa.

JUNE 13-18—Exposition of the Association of Iron and Steel Electrical Engineers at the Syria Mosque, Pittsburg, Pa. General chairman, John F. Kelly, 705 Empire Bldg., Pittsburg.

JUNE 20-24—Annual meeting of the American Society for Testing Materials at French Lick Springs, Ind. Secretary's address, Engineers' Club Building, 1315 Spruce St., Philadelphia, Pa.

AUGUST 31-SEPTEMBER 2—Annual convention of the American Railway Tool Foremen's Association at the Hotel Sherman, Chicago, Ill. G. G. Macina, secretary, 11402 Calumet Ave., Chicago, Ill.

SEPTEMBER 7-9—Seventh annual New Haven machine tool exhibition to be held in New Haven, Conn. Harry R. Westcott, Chairman Exhibition Committee, 400 Temple St., New Haven, Conn.

SEPTEMBER 19-23—National Machine Tool Builders' Association Exposition to be held in Cleveland, Ohio, under the direction of the association. For further information, address National Machine Tool Builders' Exposition Manager, Room 635, 1328 Broadway, New York City.

SEPTEMBER 19-23—Ninth annual convention and exposition of the American Society for Steel Treating to be held in Convention Hall, Detroit, Mich. For further information, address W. H. Eisenman, National Secretary, 4600 Prospect Ave., Cleveland, Ohio.

SEPTEMBER 26-OCTOBER 1—Eleventh annual exposition of chemical industries in the Grand Central Palace, New York City. For further information address Publicity Department, Exposition of Chemical Industries, Grand Central Palace, New York, N. Y.

SOCIETIES, SCHOOLS AND COLLEGES

DREXEL INSTITUTE, Philadelphia, Pa. Catalogue for 1927-1928.

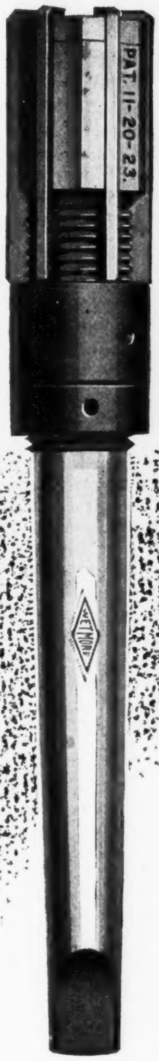
UNIVERSITY OF MISSOURI, Rolla, Mo. Catalogue for 1926-1927 of the School of Mines and Metallurgy.

MELBOURNE TECHNICAL SCHOOL, 124-126 Latrobe St., Melbourne, Australia. Prospectus for 1927, containing outline of courses, calendar, and other related data.

NEW BOOKS AND PAMPHLETS

AN INVESTIGATION OF TWIST DRILLS—Part II. By Bruce W. Benedict and Albert E. Hershey. 76 pages, 6 by 9 inches. Published by the University of Illinois, Urbana, Ill., as Bulletin No. 159 of the Engineering Experiment Station. Price, 40 cents.

5/8" to 12"



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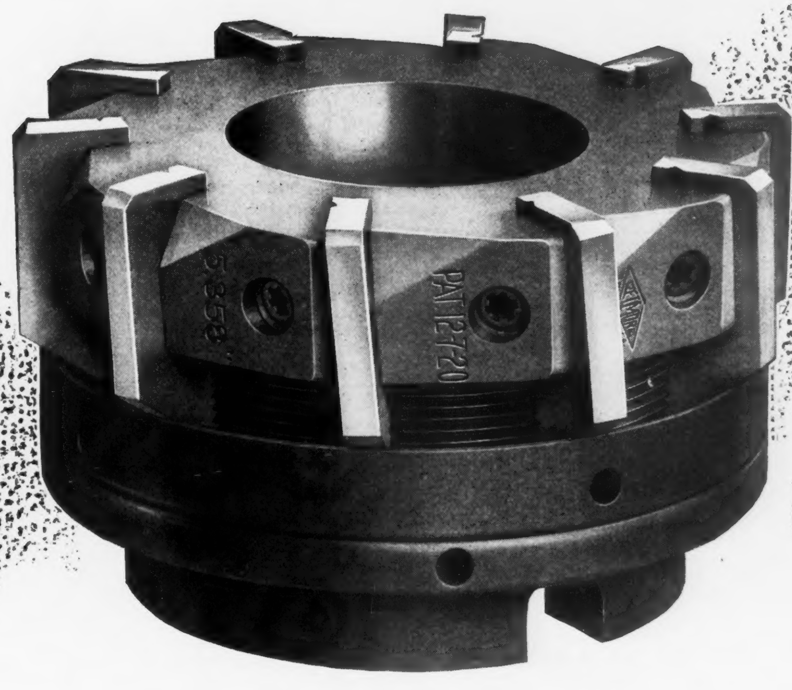

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PROCEEDINGS OF THE FOURTEENTH ANNUAL CONVENTION OF THE AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION. 176 pages, 5½ by 8¾ inches. Published by the American Railway Tool Foremen's Association, 11402 Calumet Ave., Chicago, Ill. Price, $2.50.

THE MEASUREMENT OF AIR QUANTITIES AND ENERGY LOSSES IN MINE ENTRIES. By Alfred C. Callen and Cloyde M. Smith. 77 pages, 6 by 9 inches. Published by the University of Illinois, Urbana, Ill., as Bulletin No. 158 of the Engineering Experiment Station. Price, 45 cents.

PROCEEDINGS OF THE TWENTY-NINTH ANNUAL MEETING OF THE AMERICAN SOCIETY FOR TESTING MATERIALS (Parts I and II). Part I, 1204 pages, 6 by 9 inches. Part II, 691 pages, 6 by 9 inches. Published by the American Society for Testing Materials, 1315 Spruce St., Philadelphia, Pa. Each part is available at the following prices: $6, paper-bound; $6.50, cloth-bound; and $8, half leather binding.

The proceedings are published in two volumes, the first dealing with committee reports; new and revised tentative standards; and list of standards and tentative standards; and the second containing the technical papers presented at the meetings, and the discussion of these papers.

MARVELS OF MODERN MECHANICS. By Harold T. Wilkins. 280 pages, 5½ by 8¼ inches. Published by E. P. Dutton & Co., 681 Fifth Ave., New York City. Price, $3.

This book presents, in a popular style, a summary of modern achievements in the laboratory of experimental science, and in the world of engineering mechanics. Starting with the conquest of the atom, the author touches upon the possibilities of recovering the wealth buried in the sea, and of utilizing the violet rays of the sun and the X-ray; the wonders of wires and wireless; the use of science in excavation, in charting the seas, and in tunnelling the earth; the application of the gyroscope and gyro-compass; devices for increasing the safety of aviation; the use of mechanical devices on the stage; and the development of the motor ship.

THE ECONOMIC BASIS OF FAIR WAGES. By Jacob D. Cox, Jr., president of the Cleveland Twist Drill Co. 139 pages, 5¾ by 8¾ inches. Published by the Ronald Press Co., 15 E. 26th St., New York City. Price, $3.50.

This book discusses a question of vital interest to all industry, namely, the wage problem. In the first chapter the author states the problem, and in the following chapters he discusses the economic laws underlying wages and living costs, prices, and the standard of living. He believes that through a better understanding of economic laws the struggle between capital and labor can be mitigated, so that each will have regard for the legitimate rights and interests of the other. Those who are interested in this subject will find the book written from an impartial standpoint, with the earnest purpose of contributing to the solution of this important problem.

TIPS ON LEADERSHIP. By Herbert N. Casson. 223 pages, 5 by 7½ inches. Published by the B. C. Forbes Publishing Co., 120 Fifth Ave., New York City. Price, $2.

This little book contains the life stories of twenty-five leaders in different fields of endeavor. The book is divided into two main parts, the first part being devoted to principles and information on the qualities that are necessary for leadership, and the second part containing the stories of the following men: E. W. Beatty, Luther Burbank, Richard Burbidge, The Cadbury Brothers, Andrew Carnegie, Cyrus H. K. Curtis, Thomas A. Edison, Michael Faraday, Joseph Fels, Henry Ford, K. C. Gillette, Warren Hastings, Elias Howe, Thomas H. Huxley, George F. Johnson, Isaac Newton, William Pitt, Cecil Rhodes, Lord Rhondda, Charles Seabrook, Fred Selous, Sir Swire Smith, Frederick W. Taylor, James Watt, and George Westinghouse.

NON-TECHNICAL CHATS ON IRON AND STEEL. By LaVerne W. Spring. 465 pages, 5¾ by 8¾ inches. Published by the Frederick A. Stokes Co., 443 Fourth Ave., New York City. Price, $4.

This is a new enlarged and revised edition of a book on iron and steel, written in a simple non-technical manner. The author traces the story of the iron industry from its first crude beginnings, through the various interesting stages of its evolution, down to the present day. The book is based on practical knowledge acquired by the author's many years of experience with iron and its alloys in some of the largest steel mills in the country. The present edition describes the more important improvements in the field of iron and steel. Chapters have been added describing the new stainless steels and irons, physical testing as applied to materials described in the book, the comparatively new science of making physical tests at high temperatures, and the X-ray as applied to iron and steel.

IMPROVING MANUFACTURING FACILITIES. Published in two parts; Part I, 52 pages, 6 by 9 inches; Part II, 58 pages, 6 by 9 inches. Published by the Boston Chamber of Commerce, Bureau of Commercial and Industrial Affairs, 80 Federal St., Boston, Mass. Price for each part, 50 cents.

This work contains a report on the most improved manufacturing facilities and methods developed during recent years. The work is published in two parts, the first part covering general problems, and the second part, technical problems. An idea of the subjects treated will be gained by the chapter headings. Part I: Introduction—Fields for Improvement; Simplification and Standardization; Progressive Manufacture; Possibilities of Improving Power Efficiency; Modern Ideas on Working Conditions; Selecting Employes at the General Electric Co.'s Plant at West Lynn; Contribution of Science to Manufacturing. Part II: Measurement of Productive Performance; Manufacturing Control; Routing, Scheduling and Dispatching; Advances in Internal Transportation; Modern Metal-working Machinery; Small Tools and Gages; Improving Human Relations.

NEW CATALOGUES AND CIRCULARS

TRACTORS. Monarch Tractors Corporation, Springfield, Ill. Circular illustrating and describing the six-ton model H Monarch tractor.

HEAT-TREATING EQUIPMENT. Stanley P. Rockwell Co., 66 Trumbull St., Hartford, Conn. Bulletin 2702, describing methods of applying the Rockwell dilatometer.

AUTOMATIC ARC-WELDING EQUIPMENT. General Electric Co., Schenectady, N. Y. Catalogue descriptive of automatic arc-welding machines and their application on various lines of work.

COUPLINGS. Brown Engineering Co., 133 N. 3rd St., Reading, Pa. Bulletin 28, containing a detailed description and specifications of "Kanti-Lever" resilient couplings and Brown new type shear pins.

FURNACE ARCH TILE. George P. Reintjes Co., 2517-19 Jefferson St., Kansas City, Mo. Circular illustrating and describing the Reintjes flexible arch tile for flat or stepped arches in furnaces and combustion chambers.

MILLING MACHINES. Kearney & Trecker Corporation, Milwaukee, Wis. Circular illustrating the improved Timken roller-bearing spindle incorporated in certain sizes of Kearney & Trecker milling machines.

DRILL CHUCKS. Union Mfg. Co., New Britain, Conn. Circular describing the features of construction of New Britain drill chucks. Dimensions and prices of the various sizes of chucks (with and without arbor) are included.

OPTICAL INSTRUMENTS. Adam Hilger, Ltd., 24 Rochester Place, Camden Road, London, N.W. 1, England. Bulletin describing the new developments of the company during the past year and containing a list of new instruments, recent publications, etc.

TRAMRAIL SYSTEMS. Cleveland Electric Tramrail Division of the Cleveland Crane & Engineering Co., Wickcliffe, Ohio. Circular illustrating the application of Cleveland tramrail systems for handling large units, in a number of representative industries.

WORM-GEAR SPEED REDUCERS. Foote Bros. Gear & Machine Co., 232-242 N. Curtis St., Chicago, Ill. Catalogue 300, descriptive of IXL "HyGrade" worm-gear speed reducers. Horsepower ratings, prices and weights, dimensions, etc., of the various sizes are included.

THREADING DIES AND MACHINES. Landis Machine Co., Inc., Waynesboro, Pa. Booklet illustrating Landis threading die-heads and machines in actual service in plants of various kinds throughout the country. Data on the various jobs shown, including production time, are given.

GEARS. Boston Gear Works Sales Co., Norfolk Downs, Mass. Catalogue 47, covering the Boston line of standardized gears. Tables of dimensions and price lists are given. Data is also included on chains and sprockets, speed reducers, couplings, universal joints, hangers, ball bearings, etc.

HEAT-TREATING EQUIPMENT. Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa. Catalogue 93, treating of the Homo method of tempering steel. The catalogue gives general information on principles and practice in tempering steel, and describes the Homo electric furnace and tempering method. Dimensions and prices for the different sizes of furnaces are included.

ROLLER CHAINS. Diamond Chain & Mfg. Co., Indianapolis, Ind. Pamphlet entitled "Rolling the Problems Out of Transmission," discussing the application of Diamond roller chains for the transmission of power in the general industrial field. Many illustrations are included, showing the variety of ways in which Diamond roller chains are being applied for both machinery and motor drives.

PISTON-ROD PACKING, RATCHET WRENCHES, ETC. Greene, Tweed & Co., 109 Duane St., New York City. Pamphlet entitled "The Door to Economy," containing information on the selection of piston-rod packing and describing the various styles of packing made by this concern which cover a wide range of uses. The pamphlet also gives data on the "Favorite" reversible ratchet wrench.

COLD ROLL FORMING MACHINERY, STRAIGHTENING ROLLS, AND BENDING ROLLS. Kane & Roach, Inc., Syracuse, N. Y. Catalogue illustrating various applications of straightening rolls, bending rolls, and cold roll forming machinery. Representative types of machines for a wide diversity of purposes are shown. Detailed sizes, specifications, and capacities are given in separate bulletins.

BALL-BEARING POWER TRANSMISSION EQUIPMENT. Medart Co., Potomac and DeKalb Sts., St. Louis, Mo. Circular entitled "The Medart Timken-equipped Line of Industrial Applications,'" illustrating the application of Timken tapered roller bearings in spherical ball and socket pillow blocks, hanger bearings, unit mountings, loose pulleys, etc. Price lists for the various sizes of pillow blocks and hanger bearings are included.

INDICATING AND RECORDING INSTRUMENTS. Brown Instrument Co., 4418 Wayne Ave., Philadelphia, Pa. Catalogue 33, describing in detail a number of improvements that have been made in the design and construction of Brown electric CO_2 meters. The various indicating and recording models are illustrated and described. Catalogue 75, illustrating and describing the complete line of Brown recording pressure and vacuum gages. In addition to pressure and vacuum gages, the catalogue includes descriptions and illustrations of Brown draft gages.